

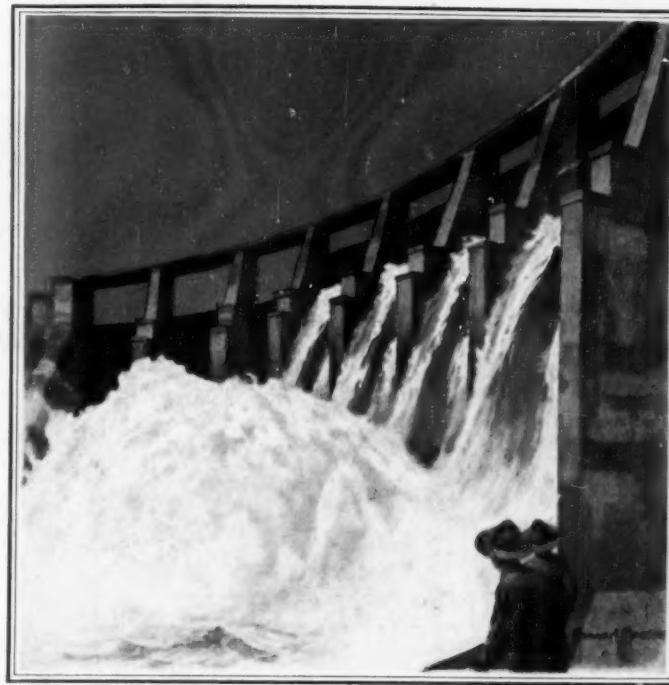
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By Dr. HENRY NORRIS RUSSELL

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		COVER	
		Our cover artist has taken for his	
		theme this month the spillway of	
		Gatun Dam at the Panama Canal,	
		and has shown the tremendous over-	
		flow that occurs during the rainy sea-	
		son. The building of the much-de-	
		layed Alajuela Dam would save this	
		water, thus giving the canal a much	
		greater ship capacity. Turn to page	
		324 for the discussion that stresses the	
		need of more water for the canal.	

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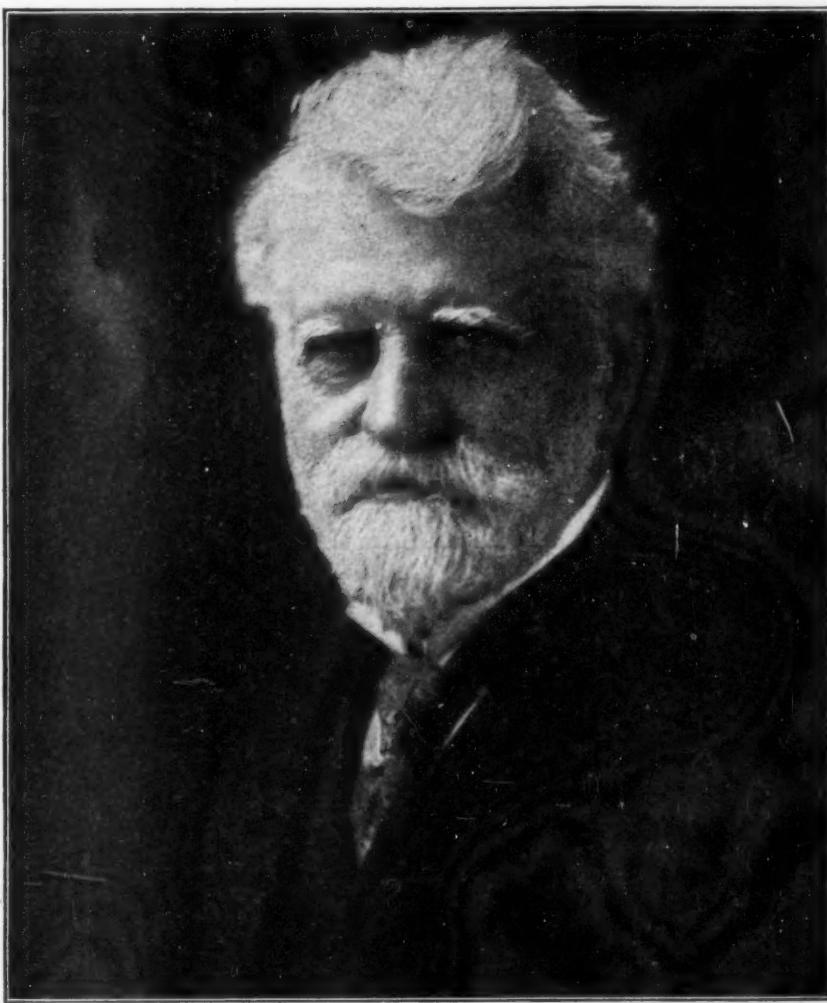
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Ambrose Swasey

SOME readers will recognize Dr. Swasey as a manufacturer of precision machine tools, while others will recall that the firm of Warner and Swasey have made most of the telescope mountings of large size for two generations past. These include the 26-inch United States Naval Observatory refractor, the 36-inch Lick refractor and the 40-inch Yerkes refractor; also the 60-inch reflectors at the Argentine National Observatory and Ohio Wesleyan University, and the great 72-inch reflector of the Dominion Astrophysical Observatory, Canada. During his long life Dr. Swasey has received many honors

and medals, both in science and engineering, including the John Fritz Medal. Perhaps his most permanent work was the founding of the Engineering Foundation, a great research organization which is exerting profound influence on the destiny of American engineering. He was born in New Hampshire, was wholly self-educated and was chosen a member of the famed National Academy of Sciences and the American Philosophical Society—highest awards of American science. Among scientists and engineers of the entire nation, few men are so highly venerated as is Dr. Swasey.



Courtesy of *The Illustrated London News*

A Catastrophe That Impends

At any minute—possibly even before this issue reaches its readers—the great land mass shown in small part at the left of the crack in the foreground, a crack which extends all the way to the cross on the distant skyline, may go thundering down from its present location on the summit of Monte Arbino in Switzerland, overwhelming the narrow valley below and indirectly destroying the community of Bellinzona. Since 1888 this

mountain top has been creeping laterally by the inch, but it now has begun to creep by the foot and the Swiss experts have ordered the danger zone evacuated. Nothing can avert the impending catastrophe which will also dam the narrow valley below to the possible height of 1000 feet, producing a lake which, when the dam bursts, will flood miles of populated lands in the valley. More specific details are presented on page 333.



Courtesy Metropolitan Museum of Art, painting by Winslow Homer, 1899

Sharks

Most Sharks Are Not Man Eaters, But Efforts to Whitewash the Man-Eating Reputation of the Fierce Great White Shark Are a Total Failure

By DAVID STARR JORDAN, Ph.D.

Chancellor Emeritus, Stanford University, Member American Philosophical Society

If sharks are fishes, the name fish requires revision with a generous expansion. "A fish is a backboned animal, fitted for life in the water; its arms and legs replaced by ear-like fins." So far, so good; all fishes are made that way; although in some of them these limbs are never fully developed.

But sharks have no scales, only a roughness of the skin. Instead of one gill opening as in fishes, they have five to seven gill slits on each side, and these with no gill covers. On the head are no "membrane bones." The jaws are quite differently made and usually provided with large teeth. Sharks have no hard bones anywhere; only gristle. There is no air bladder; and the eggs are few and very large, cast in leathery cases, and often hatched within the body.

All sharks feed on animal food, big or little, as they find it. The shark has a bad reputation and even the name has an unpleasant sound, for some sharks behave very wickedly and none are regarded as reputable citizens of the sea. Now and then a shark is accused of attacking men. But the shark has literary friends as well as enemies. Every shark atrocity story is denied by somebody, and even seamen can be

found to assert that even a 20-foot shark is as timid as a kitten, while a huge basking shark, 40 feet long is not as savage as a sawlog. That a shark will bite a man is vigorously denied, even in face of the strongest evidence.

The simple fact is that there are many kinds of sharks, ranging in size from a foot to 50 feet, and that their feeding habits vary accordingly. Some have teeth as "sharp" as shoe-buttons and others more like those of a buzz saw. A traveler may find samples of either or both kinds.

To say that sharks will or will not bite or fight is to judge the many by the few. It would be as easy to judge all wild mammals by a dozen samples, as to do so with sharks. All mammals are harmless to man if we are to judge by sheep, goats, rabbits, mice, and whales. To deal with tigers, panthers, wolves, and the great killer-whale of the northern seas, will soon change one's point of view. There is almost as much difference in size and temper within the class of sharks as in the class of mammals or that of birds or reptiles.

Sharks have lived in the ocean millions of years longer than mammals

have lived on land, and both groups have had time to diverge mightily. Fortunately the biggest and meanest of all "man-eaters" passed away long before there was any man to eat. There are about 250 species of living sharks recognized today, some of them found in every sea, but most numerous about the equator. To these we must add some 500 other species which have become extinct from Devonian days on, and are known only by their teeth or fin spines. A few are preserved in imprints on very fine strata of rock, but this is by no means common. The teeth are virtually indestructible, being covered with smooth, firm enamel.

Most savage, by far, of all living sharks, is the great white shark or man-eater (*Carcharodon*). It is a strong, swift animal, with triangular teeth about an inch long, saw-like along both edges. It reaches a length of 35 to 40 feet. It is not common anywhere, but breeds in the tropics in both oceans. Individuals stray northward in the Gulf Stream and in the Kuro-Siwo or Black Current of Japan.

A few years ago a man-eater shark, slipping along the Gulf Stream from the West Indies, approached the New Jersey coast, attacking bathers as he

went along. This naturally produced a panic around Atlantic City. In Hawaii last year a bathing soldier was devoured by a shark. Last year a young woman from Stanford University was attacked in the favorite bath-



FORTUNATELY EXTINCT

Fossil tooth, one half size, of giant white (man-eating) shark 150 feet long

ing pool on the beach near Hilo, Hawaii, and badly lacerated before the beast was scared off. That the great white shark will attack man wherever he can, is proved beyond a doubt. That these raids are not more frequent is due to his tendency to wander about, well off shore, with only himself for company.

THE only *Carcharodon* I ever saw fresh was brought to me in 1880 by the fishermen at Soquel, on Monterey Bay, California. It was 32 feet long, and had in its stomach a whole young sea lion. It is a *Carcharodon* which, according to Linnaeus, once swallowed Jonah. But unlike the prophet, the sea lion found the ventilation of his receptacle quite inadequate. Fortunately the great white shark represents a fading group.

The triangular, saw-edged teeth of the single living species of *Carcharodon* are about an inch long. But in Tertiary Period deposits of most parts of the world, teeth five and six inches long are often found. These must have belonged to great white sharks 150 feet or more in length. Two or three species of these giant teeth occur in the Miocene Epoch deposits of South Carolina and Maryland; and three in California, in which state are found also three smaller species of *Carcharodon*, with teeth of less than two inches. The earliest *Carcharodons* in America, as in Europe, are of Miocene age.

The earliest shark known in geological history, *Cladoselache*, was found in the Middle Devonian Period rocks of Ohio. It is also the simplest in struc-

ture of all yet known. It may or may not be ancestral to all other sharks. At the same time, it may be an ancestor of all the higher animals: Ostracophores, arthrodires, fishes, amphibians, reptiles, birds, and mammals. If the long series easily traceable from certain lung-fishes up to man sprang from *Cladoselache*, the separation must have been a good many millions of years ago, for the jawless, limbless ostracophores, enveloped in coats of mail, go back still farther, to the Silurian Period.

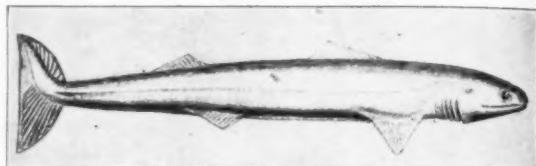
Of the earliest shark known, a full outline has been fortunately preserved in the rocks. But of the hundreds of other fossil species, we have in general only teeth and the spines of each of the dorsal fins.

The mackerel sharks, *Isurus*, are much like the man-eaters, and to fishes are equally dangerous. I have never heard that they ever assault man. These sharks are sleek and swift, their curved teeth sharp but without saw edges. In all warm seas they are plentiful, and to fishes which, like the mackerel, run in schools, they are very destructive. The longest mackerel shark I ever obtained was from Pensacola, Florida, and was 16 feet long. The common extinct species of *Isurus* were double that length and their teeth are common in the Miocene and later Tertiary. Throughout that period, teeth of *Isurus hastalis* are more often found than those of all other sharks whatsoever.

One of the largest of all sharks is the great basking shark (*Cetorhinus*), a huge, clumsy creature rolling along, almost as inert as a sawlog. This shark lives in the Arctic but occasionally drifts southward to the latitude of Cape May in the Atlantic or to Monterey in California. Its general form is not unlike that of the man-eaters, but the many teeth in its monstrous mouth are very

small and its food is made up of minute creatures which swim into its path. Some 30 years ago a number of basking sharks came down together from Alaska to California. One of them was taken and its skin salted for mounting by one of my students who sent it to Dr. Steindachner at the Museum of Vienna.

Similar to the basking shark in size and habits is the great whale shark (*Rhineodon*) of the tropics, a dozen or



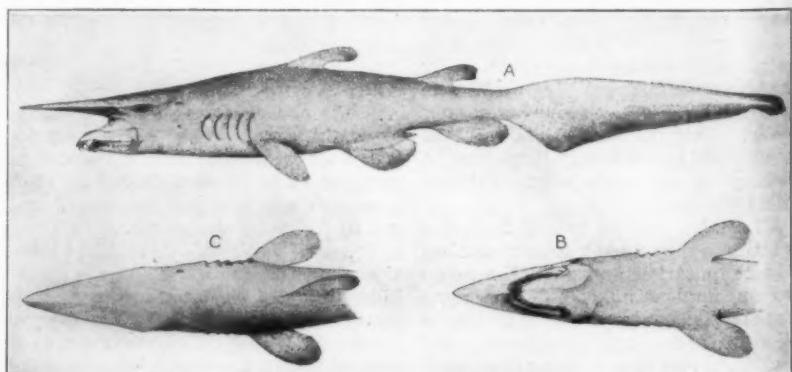
EARLIEST KNOWN SHARK

From the Devonian Period rocks of Ohio. The sharks are among the earliest fishes to appear in the rocks

so specimens being known to science.

Somewhat like the basking shark is the great sleeper or nurse shark of Alaska (*Somniosus*) whose favorite haunt is about the salmon canneries, on the refuse of which he gorges himself to repletion. The sleeper shark is a lumbering creature, about 20 feet long, weighing about a ton. It attacks whales, biting out pieces of flesh with its jagged teeth. It takes the hook readily from the deck of a steamer, but only steam tackle can draw it in.

AT the north end of Wrangel Island in Alaska is the cannery village, Fort Wrangel. Near the cannery is a small bay of an acre or two with a circular outline and a narrow entrance. This is nearly filled with fine silt. At low tide there is no water above the silty deposits. At Wrangel the tide rises to 20 or 30 feet twice each day and covers the bay. At each high tide, several sleeper sharks, gorged with salmon offal, enter the bay to "sleep it off" and as the tide recedes they flounder helplessly for a while, but at last find themselves drowned in the



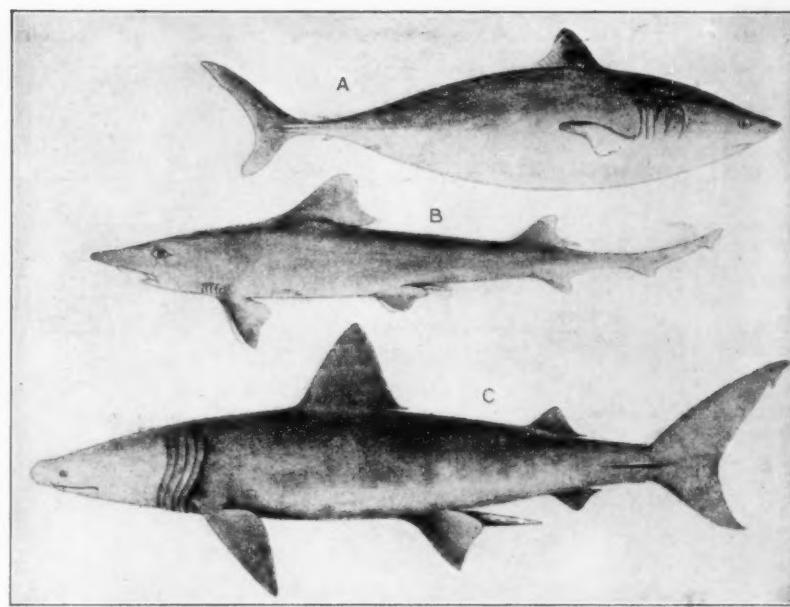
THE GOBLIN SHARK, SAGAMI BAY, JAPAN

Just as coniferous trees may be thought of as much more ancient than leaf-shedding trees, so must sharks be regarded as holdovers from a geologically early era. Essentially, they are a primitive type which have held their own against all comers throughout the long past

glacial silt. As the sleeper gives up his "shark ghost," and when the silt dries, he is far on the way to becoming a fossil or often many fossils, as his teeth become scattered in the mud. Some day when the bay is attached to dry land it will yield a wonderful deposit of shark's teeth, more remarkable even than that of "Shark's Tooth Hill" on Kern River, near Bakersfield, which has added so much to our knowledge of Miocene life.

ANOTHER queer shark is the hammerhead, (*Sphyraena*) with the head three times as wide as long, an eye set on each end of the very broad hammer. These creatures are found in most warm seas. In Hawaii and in Japan their flesh is largely used to make an inferior grade of *kamoboku* or fish cakes. In this process the shark is boiled, crushed and mixed with rice meal or other starchy material.

The thresher shark, (*Alopias*) is a very slender shark, reaching the length of 25 feet, half of which is tail. Its teeth are small and its disposition mild, though they have been falsely accused of attacking whales. This is a very ancient tradition, for observers have mistaken for a shark the great killer, (*Orcinus rectipinna*). This animal is not a fish but a mammal, a sort of porpoise but of great strength, long teeth and a fierce disposition. The earlier name, *Orca*, was earlier used for some other animal before the killer was known.



THREE SHARKS FROM THE NEW ENGLAND COAST

A, the mackerel shark, is never known to assault man. *B*, is a hound shark, Cape Cod. *C*, is a great, lazy, harmless hulk, from the Arctic, the basking shark, with tiny teeth

The killers hunt in schools, attacking a whale most viciously, holding on to his body by their strong teeth. The whale leaps into the air and rolls over and over on his side with the clinging killers which sailors mistake for thresher sharks. Ancient writers describe how threshers like flails, pound the whale from above while the swordfish stabs him from below. But both

shark and sword-fish can prove an alibi. Twice I have seen fights of this kind, once off the west coast of Mexico. It is not often that such a conflict can be photographed. It was the good fortune of Mr. W. W. Richards, of Santa Cruz, California, to witness an attack of the killers on a humpback whale, with a camera in his hand.

Of the many small sharks of various size, the dog-fish (*Squalus*) is everywhere the most abundant and most annoying. It crowds in the way of food fishes, nibbles bait, and makes itself a nuisance along North Temperate shores and occasionally so in the tropics. In the economics of the World War an effort was made to utilize its tasteless flesh after the manner of cod fish. To do this it was necessary to bap-

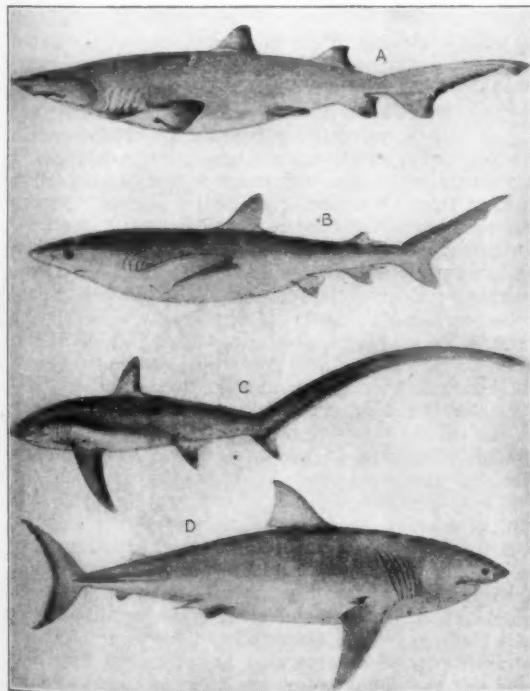
tize it as "gray-fish." But even under this appetizing label the best that could be done for the dog-fish was to use it for fertilizer.

Related to the dog-fish are the little sharklets of the deep sea, some of them with luminous glands which yield a cold green light. I once engaged the champion fisherman of Japan, the beloved Kuma (Kumakichi Aoki) of Misaki, to go out fishing for sharklets in the deep waters of Sagami Bay. He took with him a number of *daibun-awo*, lines from 1000 to 2000 feet long, with baited hooks along the sides. He brought in several new and interesting fishes and with them a number of sharklets, one of them, *Etmopterus lucifer*, a foot long, jet black with luminous green light along the sides.

THIS is the smallest of sharks, although some of the ancient fossils are no larger. Another luminous shark, *Isistius*, of the Pacific, gives out a green light. It is somewhat larger and has rarely been taken.

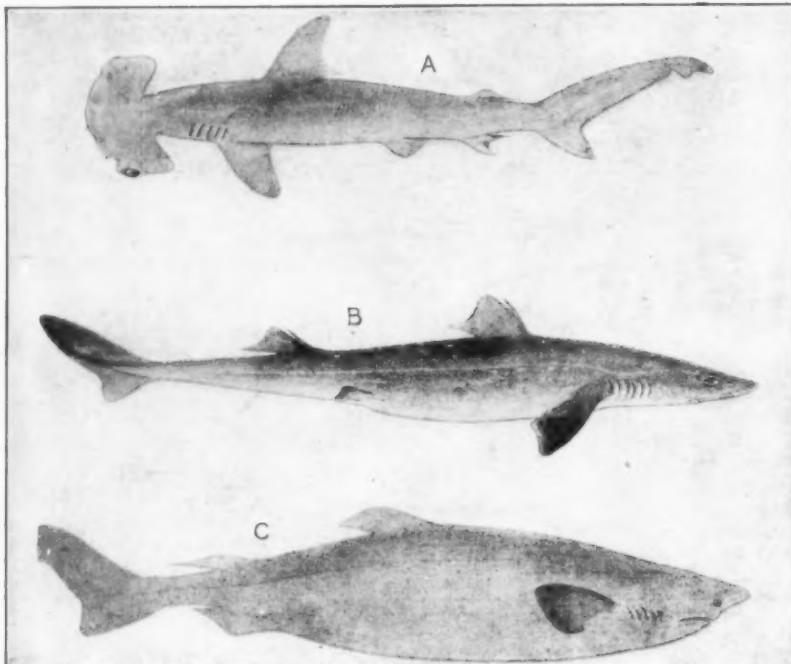
From this same Sagami Bay I obtained the first specimen of the great goblin shark (*Mitsukurina*) which has the snout lengthened as a long flat blade like that of the paddle-fish of the Mississippi. The goblin reaches a length of 15 feet, although my very young example, which I figure here, was about a foot long.

The great body of living sharks, the gray sharks or *Requiem*s belong to a single family, *Carcharhinidae*, near the middle of the series, lacking most of the special peculiarities of others. The two lobes of the tail are very unequal, the last of the gill openings is over the pectoral fin instead of behind



INCLUDING THE MAN EATER

A, sand shark. *B*, gray shark. *C*, thresher shark. *D*, the great white shark or man-eater, taken off Massachusetts



THE FORMS VARY QUITE WIDELY

A, the bizarre hammer-headed shark; eaten in Japan. B, the dog-fish which rates as a first class nuisance. C, the sleeper shark which slept it off once too often

it. The teeth are generally small and hooked, never triangular, but sometimes serrate. In some of the smaller forms, or hound-sharks, (*Mustelus*) the teeth are flat and paved with no sharp points whatever. The fin rays of some species (*Galeorhinus*) are gelatinous when cooked and are much prized for the delicious "shark-fin soup" served in China. The principal genus of gray sharks (*Carcharias*) consists of many species from three to 25 feet in length, some of them abounding in all warm bays as well as in the open sea. Although a nuisance to fishermen, they are valued in many harbors as scavengers. That some of these may attack man is possible, although the records are not convincing. One species, in southern Australia, has a bad reputation, but in general those big fel-

lows are timid, unless very hungry. The sand shark of New England, (*Odontaspis*) has the form and appearance of the gray sharks, but has long, lance-like teeth and a disposition to correspond.

I have had two experiences in fishing for large gray sharks in the tropics. The first of these was with a great hook and chain, from the wharf at Key West. Here I was assisted by the idlers about the bay, and the fishes brought up (*Carcharias commersonii*) were 16 feet long.

MORE romantic was a venture in the Pacific, on the equator, from the deck of the Australian ship, *Moana*. In that region, to the northwest of Fiji, lies a charming ring-like atoll named Mary Island, "the magic circle in the sea" of the poet, "etched on the blue with pale gray coral sand." Near this island our ship was forced to stop and anchor for a couple of hours to adjust something about her boiler. At once I got out a long line, baited it properly and sank it into the depths, in hopes of luring some freak of the abyss. At the same time I baited a great shark hook with a chunk of meat and hung the chain off the stern of the boat.

The deep-sea hook was hauled up in due time, with a large fish attached, as stiff as a log, as we drew it through the water. It proved rather unexpectedly to be a familiar fish, the wall-eye or pike perch of the Great Lakes which lives no nearer Mary Island than the Lake of the Woods in



PECULIAR TEETH

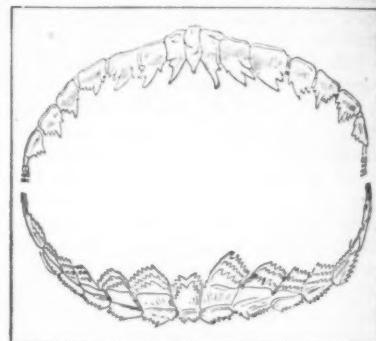
Lower jaw of Port Jackson shark, Australia, a hold-over form from an early era

the southern part of the Canadian province of Manitoba!

Unlike the current writers of unnatural history we did not jump at rash conclusions in this matter. We did not imagine an underground connection between Mary Island and the Lake of the Woods. We rather suspected a junction with the ship's ice-box, the *Moana* being an Australian steamer out bound from Vancouver.

And this indeed was the case, for the wall-eye was still frozen, and we could imagine the silent humorist below decks, who had drawn in the line and put a fish on the hook, to save us from disappointment. So we cast the wall-eye back into the sea, and turned our attention to the lure for sharks.

The sharks were likewise interested. A great gray fellow swam near,



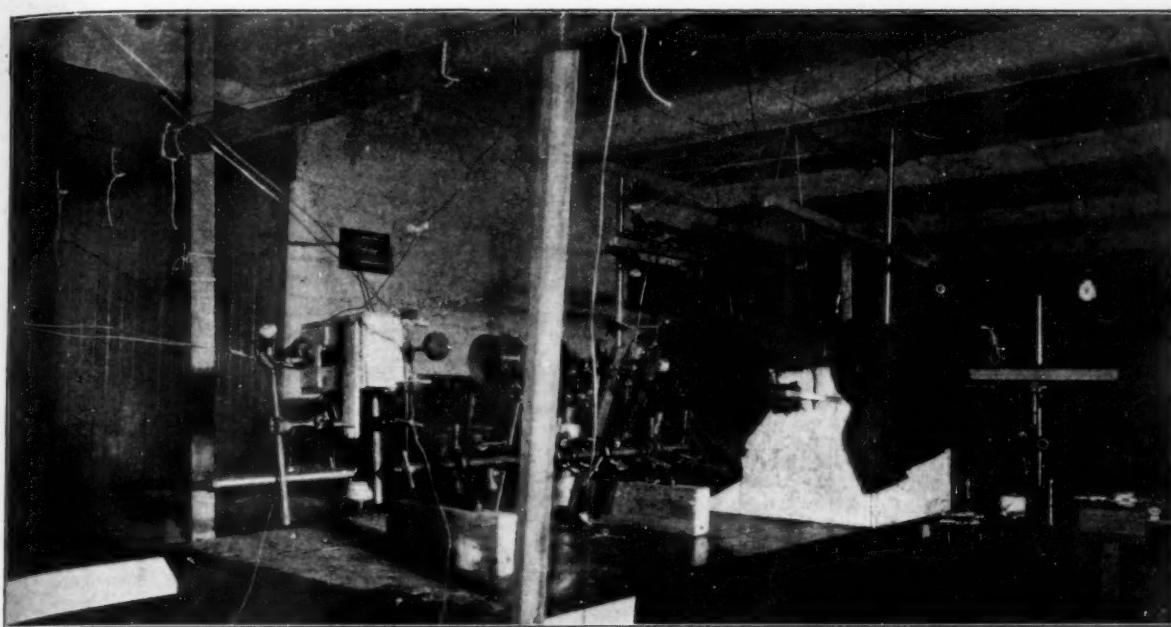
INVITING JAWS

"Give up all hope, ye who enter." Teeth of a primitive type, Pacific Ocean

ing bright green under the blue water, the white tips of his fins shining like emerald. These white tips scarcely show when the fish is dead, but in the water they furnish for this species a most conspicuous recognition mark.

The big, lustrous, bullheaded fellow was nosing the bait. He was very dubious about it and left off and on, for half an hour, before, with one great gulp, he swallowed it. In a minute he was flapping madly in the air against the stern of the boat, with all the cabin passengers tugging at his chain. His three-cornered, saw-edged teeth went as souvenirs to the ladies. His fins were used for wings for Bosco, the messenger-boy in our ship's "circus," and in his stomach we found an iced cold wall-eye from the Lake of the Woods!

Our first shark was young and unsophisticated, its length being only about 12 feet. On our casting him back into the sea, without jaws or insides, the other monsters about became interested and one more of about the same size had time to take the hook before the steamer started again. He too had in his stomach a frozen Canadian wall-eye from the Lake of the Woods!



THE APPARATUS EMPLOYED IN THE EXPERIMENT AT SLOANE LABORATORY AT YALE

The photo-electric cell is in the wooden box in the foreground. To the left of the box are the Kerr cells, the lenses and the spark gap. The latter is connected to a system of wires, which control the timing, extending out of the photograph for a distance of 20 yards

What Is Light?

With An Apparatus Which Turns Light Off and On In One Thousand Millionth of a Second, It Has Been Shown That Light Quanta Must Be Less Than a Few Feet In Length

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LIGHT is one of the most familiar physical realities. All of us are acquainted with a large number of its properties, while some of us who are physicists know a great many more marvelous characteristics which it displays. The sum total of our knowledge of the physical effects produced by light is very considerable, and yet we have no satisfactory conception of what it is.

At first sight it seems a bit odd that we should fail to understand something about which we know a great deal. A moment's thought resolves the paradox, however, for we realize that a thing which exhibits a large number of different characteristics is most difficult to form a picture of. And so, from time immemorial, man has wondered about the nature of light.

More than two centuries ago Newton conceived that light was corpuscular in nature; he believed that light consisted of little darts shooting through space. Others regarded light as a wave phenomenon; in a manner analogous

to the propagation of waves in water, light waves were propagated in a medium pervading all space, called the ether. A lively controversy ensued between the adherents of these two conceptions of the nature of light and as new experiments were carried out revealing more of its properties, it appeared that the undulatory theory accounted for many things quite unintelligible on the corpuscular hypothesis.

TOWARDS the close of the nineteenth century, physicists settled down to the complacent notion that they fully understood the nature of light—for the picture of waves flowing in the ether explained practically everything known about light at that time.

They were soon disturbed from their complaisance, however, by the discovery of some effects produced by light which were quite unintelligible on the undulatory theory. For example, it was found that when a metal surface is illuminated by light of a suitable

color, electrons are ejected from the surface with velocities depending only on the color of the light and quite independent of the intensity of the light. This phenomenon is now called the "photo-electric effect." It was quite as surprising to observe that electrons were ejected with great velocities from metals by faint light as it would be to observe a small ripple on the surface of the ocean suddenly causing a timber to be torn loose from the side of a ship and thrown high into the air.

The observation that the velocity with which the light ejected the electrons was quite independent of the intensity of the light, but depended only on its color (wavelength) strongly suggested that Newton was right after all; for if light consists of darts of energy of definite amounts shooting through space, it did not appear at all improbable that a "collision" of such a light dart with an electron would result in the absorption of the entire energy of the dart, the electron acquiring thereby a definite velocity.

As time has progressed, many additional phenomena concerned with the interaction of light and matter have been discovered which are impossible of understanding on the wave theory and which have compelled scientists to revert to the conception of light which was in Newton's mind centuries ago. Such recent facts of observation suggest that light beams contain amounts of energy which are exact multiples of a definite smallest amount—a light quantum—just as matter seems to be made up of definite multiples of a smallest particle of matter or electricity—the electron. Thus, we have atomicity of light as well as atomicity of matter and electricity.

A SEEMINGLY very peculiar circumstance exists in this modern quantum theory of light, for the very thing concerned in the theory is entirely obscure. The quantum theory tells only what effects the light quanta produce when they are interacting with matter, and does not tell very much about the quanta themselves. It is as though in describing an artillery battle we told where the shells went and the damage they produced, but refrained from mentioning how large the shells were and how they were constructed to produce the explosive effects which were observed. It would have facilitated the description of the battle if the size and kind of ammunition were known, and in just this way the quantum theory of light would be much more complete if the precise physical nature of the quanta was given.

And so the question of the physical nature of quanta presents itself. Are they a yard or a mile or an inch in length, or are they of infinitesimal dimensions? Many experimental facts can be interpreted as indicating that quanta are at least a yard in length, yet nothing really certain can be inferred from past observations. The dimensions in space of the quanta remain complete mysteries.

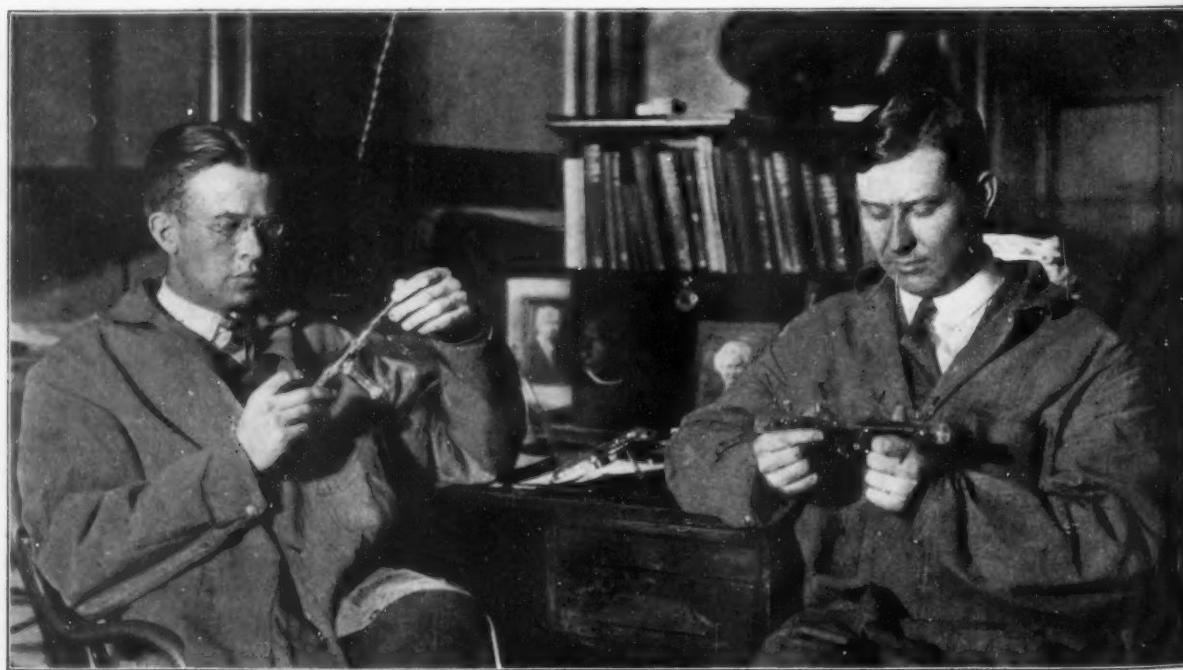
THREE is at least one way of measuring the length of quanta, provided that the scheme may be carried out in practice, which is essentially as follows: Suppose one had a light shutter that could obstruct or let pass a beam of light as quickly as desired. Such an apparatus would be able to cut up a beam of light into segments, much in the same way that a meat cutter slices a bologna sausage. It is clear that if the slices of the light beam so produced were shorter than the light quanta in the beam, the short light flashes coming from the shutter would contain only parts of quanta. In effect, the apparatus would be cutting off the heads or tails of quanta. To eject an electron from a metal surface a whole quantum is necessary because part of one quantum does not contain enough energy to do the trick. One therefore would definitely establish an upper limit to the length of light quanta by simply observing the shortest light flashes able to produce a photo-electric effect.

Since light travels with a velocity of 186,000 miles per second—fast

enough to go around the world more than seven times in one second—a light shutter capable of cutting a beam into segments a few inches in length obviously must operate with tremendous rapidity. To produce a slice of light one inch or three centimeters long, for example, the shutter must remain open only one ten thousand millionth of a second. A camera shutter which remains open for one ten thousandth of a second is considered very fast indeed. A shutter able to produce these short light flashes is necessarily a million times as fast.

ONE does not have to be very familiar with mechanical things to realize that no mechanical shutter could possibly work at this speed. Earlier in this article it was noted that quanta are probably not much longer than a yard or so, and hence mechanical difficulties would seem to render it impossible to carry through the experiment. Happily, however, Nature has endowed matter with properties other than purely mechanical ones. By making use of a certain electro-optical property of some liquids a device was conceived which actually operated as a shutter, turning on and off in about one ten thousand millionth of a second. To understand fully the operation of this electro-optical shutter a considerable familiarity with optical things is required. The general idea, however, may be made clear from the following account.

A beam of light readily passes through two crystals of tourmaline



THE TWO EXPERIMENTERS, DR. LAWRENCE AND DR. BEAMS

Dr. Lawrence (left) holds in his hands the photo-electric cell which creates a current automatically when light impinges upon it. Dr. Beams holds a double Kerr cell containing brass plates and carbon bisulfide. This is described in the text of the article

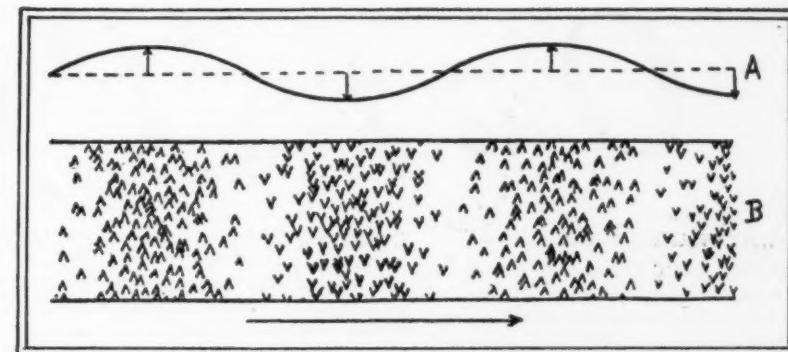
when the crystals are placed exactly similarly along the path of the beam, but it cannot pass the second crystal if it is turned about the light beam as an axis through an angle of 90 degrees. The light from the first tourmaline which possesses this remarkable property of being unable to pass through a second crystal placed a certain way in the path is called plane polarized light.

It is known also that if liquid carbon bisulfide is placed between the crystals these polarization effects are unchanged except when the liquid is in a strong electric field. Then it is found that no matter how the second tourmaline crystal is twisted, a part of the light passing through the first crystal and through the carbon bisulfide manages to pass through the last tourmaline.

It is further true that on introducing a second tube of carbon bisulfide between the tourmaline crystals in which there is an electric field of equal intensity but having its direction at right angles to the direction of the field in the first cell, the combination acts as though only air filled the space between the crystals. That is to say, light does not pass the combination when the second crystal is suitably oriented.

These facts make it clear that the problem of allowing light to pass through for a very short time is simply reduced to finding a way of turning off the electric field in one of the carbon bisulfide cells a corresponding length of time before cutting off the field in the other.

Thus, this scheme makes it possible to produce light flashes of one thousand millionth of a second duration, provided a means is at hand to cut off an electric field across one pair of condenser plates immersed in carbon bisulfide one billionth of a second before cutting off the voltage across a similar pair in another cell of the liquid. Perhaps one would at sight be tempted to regard as nearly impossible the feat of turning off two electric



TWO CONCEPTIONS OF THE NATURE OF LIGHT

A is the wave theory, the arrows indicating the direction of the electric field. In B, each check mark represents a quantum moving to the right and generating a force as in A

fields in such a way that it was known that one dropped to zero only one thousand millionth of a second before the other—or as nearly impossible as would be the construction of a mechanical light shutter able to turn on and off a light beam in the same short time. But again Nature happily has provided electricity with properties which make the stunt quite easy.

A finite time is required for the propagation of electrical effects along wires. For example, if two wires are attached to a battery, the other ends of the wire are affected, that is, they acquire a voltage, at a time after the wires were attached to the battery equal to their length divided by the velocity with which electrical effects are propagated along wires. This velocity is very nearly the same as the velocity of light.

AND so, if wires are attached to the two pairs of condenser plates immersed in carbon bisulfide and charged to a high voltage, and the other ends of the wires are short-circuited, one pair will discharge before the other if the length of wire to one is greater than to the other.

In the actual experiment, the short-circuiting was accomplished by having the wires attached across a spark gap. The moment a spark jumps, the resistance of the gap is reduced.

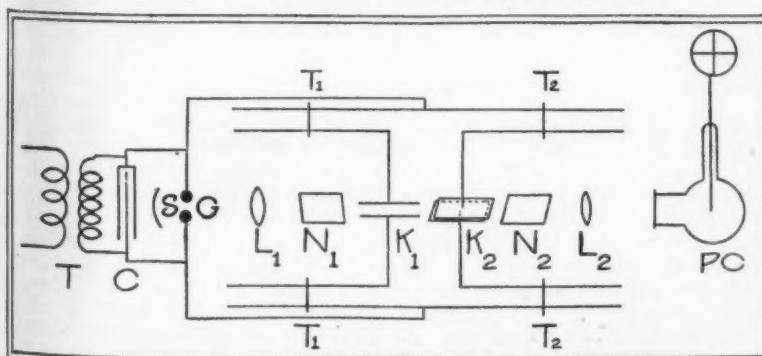
Thus the time between the disappearance of the electric fields in the two tubes of carbon bisulfide was varied by simply increasing or decreasing the lengths of the wires connecting one of the cells to the spark gap. It is outside the scope of this article to describe the operation of the shutter in further detail, but the general idea has been made clear.

The short flashes of light produced in this way were allowed to fall on a sensitive photo-electric cell, and it was found that the cell responded to the shortest flashes obtained—which were only a few feet in length.

Of course the short flashes did not produce as great a photo-electric emission of electrons, because the total amount of light energy was less. But the important observation was that the shortest light flashes were able to eject some electrons from a metal surface.

THE importance of this simple experimental observation cannot be overestimated, for it definitely demonstrated that light quanta are less than a few feet in length and probably occupy only very minute regions of space. The experiment also showed that an electron absorbs enough energy in one thousand millionth of a second to fly out of a metal with a terrific velocity.

This result is in accord with very recent theories of light. Dr. W. F. G. Swann, Professor J. C. Slater and others have a short time ago suggested that light has a dual nature; that there are both waves and quanta, the waves merely determining where the quanta may go. Quite independently, Sir J. J. Thomson also has developed this idea in considerable detail. According to Professor Thomson's views, the quanta are little rings of electrical lines of force, like doughnuts riding along on the waves, so that in the short light flashes of the experiment described above there were many whole quanta able to knock out electrons from a metal—just as the experiment has demonstrated.



Courtesy Proceedings National Academy of Sciences

DIAGRAM OF THE SET-UP SHOWN ON PAGE 301

Two lenses L; two Nicol prisms N; two sets of parallel brass plates K; two sets of variable wire lengths T; and a potassium photo-electric cell P C, make up the bulk of the equipment

Our Point

WHY PERPETUATE A FAILURE

PRESIDENT COOLIDGE has the country solidly behind him in the matter of the Shipping Board and the government-owned merchant ships. He believes that these ships should be sold to experienced American shipowners, who alone have the knowledge, experience, and strong commercial incentive, which are absolutely necessary to the operation of a successful merchant marine.

The Shipping Board has had its day of trial, and its failure has been definitely recorded in an annual deficit, which started at the enormous figure of 50,000,000 dollars, and today, after nearly a decade of trial, represents an annual loss to the nation of some 20,000,000 dollars. There is no explaining away these figures, although the Shipping Board would have us believe that its lamentable failure is due, in large part, to hostile propaganda on the part of its competitors. It has become too much the habit of political institutions like the Shipping Board to explain away their failures by representing themselves as the victims of foreign machinations.

All of which is usually mere poppycock. Certainly it is nothing more in the present case. There is no sentiment in trade. Those who ship their goods by the ocean routes choose the ships which will carry their goods most conveniently, most expeditiously, and most cheaply.

The Shipping Board has been a costly experiment, as all government ownership and operation of ships has been. Canada tried it and failed; Australia has sold or is selling its ill-fated government fleet. We must do the same.

Long years of experience have proved that a privately-owned fleet, unhampered by government interference, is the only plan that will meet the situation.

WHAT IS FOUL AIR, ANYWAY?

IS the ventilation good or bad in the theaters of your own community? New York City, which has seldom been known to hide her light under a bushel, boasts several scores of playhouses which are patronized by an army of human beings eight times a week. And one hour after the curtain has risen the air in most of these playhouses is unfit for human consumption. Can anything practical be done about the foul air in the average theater?

New theater buildings, especially

those designed for motion pictures, are usually equipped for indirect ventilation; some of them for scientific air conditioning. Admittedly, equipment of this kind for old theaters would cost money, but New York theaters make money. Today, ventilation engineering is a science. It is easy to provide for proper ventilation but it can not be done by guessing or by any other rough-and-ready method; nor even by no method at all. Why should any human being living in this boasted

ing places there is never as much as a 1 percent oxygen depreciation and rarely that—this on the authority of the noted Dr. Leonard Hill of England, whose physiological researches are famous. Dr. Hill also asserts that the carbon dioxide given off in these places is never harmful, and that the "subtle organic poisons" alleged to come from human lungs do not exist. Why, then, do we become uncomfortable?

What causes the discomfort, according to Dr. Hill, is not a chemical factor but physical. The body must continue at all times to lose heat. It was made that way. If the humidity and temperature become so high that the body can no longer lose heat, we begin to feel uncomfortable. The remedy is not necessarily fresh cold air which, as any theater proprietor already knows, always encounters almost superhuman objections from old ladies of both sexes, but it is air in slow motion, scarcely perceptible but constant. Given this, according to Dr. Hill, outside ventilation may even be dispensed with. In this there is a tip for the theater owner. Another is to study well the noted New York State Report on ventilation.

Must the public always expect to obtain its theatrical amusement from the Black Hole of Calcutta? Will some of the owners of the older theaters install modern air control apparatus, or don't they give a tinker's damn about the public as long as the shows continue to be patronized?

THE FOUR-DAY LINER PROPOSAL

THE Camden firm which built the 33-knot airplane carrier *Saratoga* has made a serious proposal to build, with government assistance, four liners, capable of crossing the Atlantic in four days. They will do this if the government will lend 75 percent of the cost of construction at the government rate of interest. There is a precedent for such a loan in the case of the *Lusitania* and *Mauretania*, for whose construction the British Government loaned the Cunard Company the necessary funds at the rate of 2½ percent. To ensure a four-day crossing, the boats must show a sustained sea speed of 31 knots. From the point of view of the naval architect, it would be perfectly possible to build four liners of this speed; for the *Saratoga*, 875 feet in length can make 33 knots and the *Hood* is good for 31½ knots.

It Is Too Bad

BECAUSE of a quibble over a placard, the famous biplane in which the Wrights made their first successful flight at Kitty Hawk has been shipped to England. Orville Wright wanted this historic exhibit to go to the Smithsonian Institution in Washington, and so did every other American. Instead it has gone to the Science Museum at South Kensington, London, because the Smithsonian Institution and Orville Wright could not agree concerning the precise wording of the placard which was to be attached to it in the American institution's museum.

Everybody knows the various arguments, pro and contra, involved in this dispute, for the newspapers have presented them many times in the past, hence we need not review them here. Regardless of who was in the right—if indeed either party to the controversy was wholly so—the fact remains that the famous plane has probably found a permanent home in another country far from the scene of its epochal successes. This circumstance detracts somewhat from our vaunted Anglo-Saxon flair for finding a practical compromise out of difficult situations.

All that can now be said is, "too bad."

century of scientific advance pay out smart sums for seats to a performance and then endure air more foul than he would prescribe for a herd of cattle?

Contrary to widespread belief, the discomfort we feel at large gatherings of people, the stuffiness, the hot prickly feeling of the cheeks and other symptoms of acute discomfort, are not due to the oxygen vitiation of the air. Air contains 21 percent of oxygen, and many analyses of foul, "breathed-up" air prove that even in the worst ventilated theaters and other gather-

t of View

But could a fleet of four-day boats be run at a profit under private management? That is the question.

In the first place they would have the immensely favorable handicap of cheap first cost, due to the low rate of interest on the capital investments. They would be engined with the very latest form of motive power, consisting of small, high-speed turbines, using high-pressure steam of 500 pounds or more to the square inch, and either mechanical or electrical reduction gear. As compared with existing liners, which run at a sea speed of about 22 knots, they would reduce the passage by a day and a half. Since a large modern liner will carry from three to four thousand people (passengers and crew), the savings in food, light, water and, above all, in the payroll and in the consumption of fuel, due to the shortening of the trip by 36 hours, would run into very large figures, sufficient, in all probability, to more than offset the larger fuel consumption due to the high speed. Lastly, the prestige of crossing on these "crack" ships would make such an appeal to the ever-increasing *noreau riche* that full passenger lists would be assured.

WHO SHALL DECIDE, POLITICIANS OR SCIENTISTS?

LOCAL politicians in Arkansas are trying to get the government to set aside part of one of the national forests in that state as a national park. Officials of both the Forest Service and the National Park Service oppose this move. They declare that the area in question is below national park standard.

The National Parks Association believes that, if the bill which Representative Wingo of Arkansas has introduced into Congress should pass, it would establish an excessively dangerous precedent for looting national forests to make inferior national parks. It would take national park selection out of the hands of the government and place it in the hands of local politicians.

The United States Forest Service is under the Department of Agriculture. The Bureau of Parks is under the Department of the Interior. This does not always help matters when such an issue as this one comes to court. Both services should come under the same department.

The national forests are forests. They are reserves of trees—lumber for present and future economic use. The

national parks are for recreation—for the immediate use of the people. But the people do not always use well their own property. Where parks are, there occur forest fires. And the stand of lumberlike trees in the national forests is steadily dwindling before the ravages of fires started by careless campers.

The argument that this state or that state must have a national park, simply because it is a state, is puerile. Perhaps the demagogue originates this argument. He surely exploits it.

If the future American nation is not to discover its forest conservation plan cut up and botched by the immediate demands of local politicians, those who

Take Note, Young America

MANY years ago the writer rode to Chicago and back in the cab of *The Twentieth Century*. Some eight or ten different engineers were at the throttle. We left the train at New York with the conviction that never had we met a finer body of public servants than these.

That trip was brought to mind by the affecting scene at the Hoboken Terminal of the Lackawanna Railroad, when his fellow workers presented a gold watch to 70-year-old "Ben" Locke as he was starting on his last run, at the close of 48 years of continuous service at the locomotive throttle. This doughty veteran, during that period had hauled his precious human freight for a total distance of some 3,000,000 miles, and this, according to the official record "without a single fatal accident." Says the official report, "never has he been reprimanded, or reported for laxity, insubordination, or impoliteness." Let the youth of America take note of "Ben" Locke.

are capable of judging dispassionately without local bias and on a basis of scientific knowledge must be the ones to decide which areas shall be set aside as parks and which shall not.

Keep heedless hands off the national forests.

A WHITE ELEPHANT

THE process of synthesizing ammonia for fertilizer manufacture has developed so rapidly during the last decade that the nitrogen-fixation process for which Muscle Shoals was designed is no longer profitable. The

electric power which this plant would use is worth more for other purposes, while the synthesized ammonia is cheaper. And so, Muscle Shoals is on our hands, rapidly depreciating, and its machinery becoming obsolete while the people of the United States are still paying off the debt incurred in its building.

What is to be done with this 160,000,000 dollar white elephant? Obviously, since it can not be profitably operated for the manufacture of cheap fertilizer, here lies dormant potential power for the operation of many industries awaiting only a plan and the touch of human hands. Comparatively little further work for its completion is necessary.

Many plans for its operation have been advanced—some practical, others foolish or costly, but none that has met with the approval of legislative bodies. The proponents of a recent one start from the premise that "the great natural resource should be exploited for the benefit of the majority of the people within the states to which its power can be economically distributed," and urge that when leasing Muscle Shoals, the government's contract provide a guarantee that its power be distributed in Mississippi and other southern states and offered for sale—to the end that the industrial prosperity of the states it will serve may be quickened to more economic and efficient development.

This seems to be a good plan, but—although the South is making rapid strides industrially, it still has far to go before it will be able profitably to distribute and use the enormous power which Muscle Shoals can generate. Now, if someone can advance a workable plan for the concentration of industries, or one calculated to bring new manufacturing interests into this section, the only thing left to do will be to find a lessee for the plant who will make an offer so far in excess of Henry Ford's "six cents on the dollar" that it will meet with the approval of Congress and the public generally. In any event Congress should at once adopt some kind of water-power policy to take care of this and other such problems.

In the meantime, the public, grown callous, awaits further developments, and retains a little hope that the problem will be solved before the plant becomes the subject of archeological research by some future race.



EARTHQUAKE DESTRUCTION IN PALESTINE

Natives of El Ranch, near Nazareth, returning to their homes to recover household articles after the recent earthquake. Note the loose round stones which, with mud for mortar, formed the walls of these rather primitive dwellings.

World Earthquake Belts

*The Widespread Risk of Earthquakes Is Poorly Realized.
Earthquake Resistant Buildings Are Entirely
Practicable Without Excessive Cost*

By BAILEY WILLIS, C.E., Ph.D.

Emeritus Professor of Geology, Stanford University; President, Geological Society of America; Ex-President, Seismological Society of America

AN earthquake is a sudden push followed by rapid vibrations. At Santa Barbara, California, in the early morning of June 29, 1925, a heavy man was sitting on the side of his bed to put on his socks. He did not put them on. An earthquake hit him from the southwest (he was facing northeast) and he went over on his back. He jumped up and ran, barefooted, out on the lawn. There the vibrations struck the bottoms of his feet, several times to the second. At that point they were vertical because he was nearly over the center of the shock. I was four miles away to the east, in bed, facing south. The first impulse threw me up on my hip and the vibrations, which were more nearly horizontal, twisted my mattress rapidly to and fro so that I had to hold on.

NOW if you think about it, you wonder what could start that impulse. What is the mechanism? We learned the answer from the California earthquake of 1906. It was a most instructive quake. There were no volcanoes connected with it, so that idea was not involved. It was simply

a sudden slip on an old rift in the Earth's crust. Of course it was rather a large slip. The crack was more than

crack jumped on an average eight and a half feet past the block on the northeast. The greatest displacement was 21 feet, as measured by the offset of a fence, which was cut across. The duration of the shock was 40 seconds, so this jump was made by a good many hundred thousand cubic miles of rock in 40 seconds or less.

The energy thus suddenly let loose is incalculably great. How could it have been accumulated? Not quickly; no, only very, very slowly by increasing pressure and elastic distortion of the rock masses.

THINK of an elastic steel bar bent to one side by a slanting pressure against its end, until the strain in the bar equals the friction. Then it will jump back, releasing instantaneously the force that was exerted to bend it. That is what happens in earthquakes. The steel bar corresponds to a mountain block of rock. The rock, under pressure, becomes as elastic as steel. It is gradually strained out of shape. The trigger is pulled back, so to speak. The strain eventually becomes too great for the resistance. The block jumps back into shape. A shock or im-

Editor Makes An Error

IN preparing Dr. Bailey Willis' article on "Growing Mountains" for publication in last February's issue, one of our editors wrote as part of the subtitle, "Volcanoes Occur Where Mountains Are Being Elevated." To have expressed the author's views, this should have read "Earthquakes Occur Where Mountains Are Being Elevated." Other statements not strictly in accord with scientific facts crept into the legends beneath the illustrations and the editor accepts responsibility for them also. As slips of this character embarrass a scientist, the editor is sincerely glad to make the present explanation, for he is always anxious that our contributors shall be placed in the right light before their readers.

180 miles long and was estimated to be at least 25 miles deep. It was tight, yet the block southwest of the

pulse results and the vibrations follow as the great masses once more seek an equilibrium.

The question naturally arises: How often does this happen? About every hour somewhere in the world. About 9000 earthquakes are recorded every year on the instruments adapted to that purpose. Many of them are slight. About 5000 would be perceived by us in the vicinity of the origin and some of them would startle, injure or kill us if we were indoors. Something over a hundred would do more or less damage in settled countries where they might hit weak buildings. The areas where there are no such structures are, however, very large and we hear of only a small percentage of the shocks, even of the heavier ones. The occasional severe shocks that happen to affect densely populated areas take an unreasonable toll of life and property because we build with criminal indifference to the risk, even when warned.

THIRTY years ago very little was known about the distribution of earthquakes in different parts of the world, although instruments designed to register their occurrence had been invented and lost during previous centuries. The oldest was invented by a Chinese scholar about the year 136 of our era. It consisted of eight dragon mouths arranged about a metal globe with a loose ball in each mouth. Within the sphere was a pendulum which would cause one or another ball to roll out according to the direction of its swing, which depended upon the course of the earthquake wave.



CHARACTERISTIC DAMAGE

House in Ramleh, Palestine. The prevailing type of construction frequently suffers

Annual Frequency of Earthquakes In the More Seismic Regions

Regions	Earthquakes Felt			Heavy Shocks, Instrumentally Registered		
	Total No.	Severe % of Total	% of World Total	Aver. Ann. No.	No. of Centers	Grade of Heaviest on Record
Chile, especially Atacama deep	1000	4.5	21.0	4.6	15	Great
Japan and Japanese deep	431	5.0	9.0	16.2	21	Great
East African Rift zone	300	3.0	6.0	2.0	8	Great
East Adriatic, Dinaric Alps	194	9.0	4.1	3.2	4	Moderate
Apennines	184	3.6	3.9	3.4	14	Moderate
Mountains of Thrace, Bulgaria	169	4.2	3.6	4.2	10	Great
Greece and Ionian Islands	145	2.4	3.1	1.2	6	Moderate
Philippine Islands and deeps	141	2.0	3.0	7.3	26	Great
Calabria and northeast Sicily	116	2.6	2.4	0.6	3	Great
Southeastern Alps, Dolomites	102	2.0	2.2	0.2	1	Slight
Mexico and Acapulco deep	98	2.0	2.1	2.1	10	Great
Guatemala	91	0.7	1.9	0.7	4	Great
California	81	0.8	1.7	0.5	3	Great
Tonga, Kermadec deeps, Oceania	...	...	...	3.9	12*	Great
New Guinea and Bismarck archip.	...	...	...	2.4	9	Great
New Hebrides, Fiji archipelago	...	...	...	2.1	9	Great
Sumatra, Java, Sunda deep	...	...	...	1.9	16	Great
Aleutian deep	...	...	...	1.2	7	Great
Peruvian deep	...	...	...	1.0	4	Great

Various other crude devices preceded the modern instruments which first began to take shape in the hands of English and German investigators from 1870 on. These scientific devices, although of several forms, all consist of some type of pendulum that controls a recording point. As long as there is no vibration a straight line is drawn. When vibration occurs, the point swings back and forth in such a manner as to write what we may call the signature of the earthquake. It consists of a sharply zig-zag line which gives the number of vibrations per second and the width of the swing. These represent respectively the period and the amplitude of the oscillations.

Such a signature is unintelligible to the uninitiated, but the mathematical physicist is able to distinguish the records of successive waves which, traveling at different speeds, have become separated in their journey through the Earth, and to deduce the distance they have traveled from the point of their common origin. He thus locates the position of an earthquake regarding which no other information may ever be received.

The record at any one station gives only the distance from that station to the origin. The latter may lie anywhere on a circle drawn with that radius. Given, however, the distances from three stations, there is but one point where the three circles can intersect, and that point must be the origin. Thus it is that by co-operation between observers we are able to locate the centers of all notable shocks. Sometimes a hundred or more seismograms, as the records are called, may be studied.

By patient observation and calculation seismologists have thus surveyed the Earth and have determined the positions of the active earthquake zones, within which they recognize centers at which shocks occur most frequently or with greatest violence. These results, when placed upon a map of the world, give us a picture of the activity of the forces in the laboratory of the globe, and it should be remembered in looking at the map that it represents data received from every active part, from beneath the oceans and from the continents. It is not necessary that man should be on the spot; on the contrary he learns more surely where a shock has occurred from the messengers it sends through the depths.

THE world-survey for earthquake centers has shown that they are distributed in zones which correspond with the deeper parts of the oceans, or which cross the continents where deep seas once divided the lands. One great belt of oceanic deeps borders the two Americas, South and North, extends down the coast of Asia into the East Indian archipelago, and continues toward New Zealand. It thus almost surrounds the Pacific, the vast ocean that covers half the globe.

Earthquakes originate in these deeps, with greater frequency in some than in others and with very unequal intensity, but quite clearly with some connection with the area of subsidence. The lands adjacent to the deeps carry mountain chains, some of them, like the Andes, among the highest of the world, and these mountains are being pushed up as the deeps deepen. The common notion that earthquakes are due to sinking of the land is in direct

contradiction with the known facts.

A deep, north of the island of New Guinea, is an active area of the circum-Pacific belt and from it there extends westward a continuation or second belt, that runs through Java, Sumatra and the Bay of Bengal into the Himalaya range of India and Tibet. That great mountain zone was, in a fairly recent geologic age, a strait or "mediterranean," which divided the plateau of India from the Asiatic continent. The uplift that has carried marine fossils up to the height of 27,000 feet in Mount Everest is still in progress and is accompanied by earthquake shocks which sometimes attain extreme violence.

From the Himalayas the earthquake belt passes westward through Persia and Asia Minor to Greece, Italy, Spain, and the eastern Atlantic. It does not cross that ocean basin, although centers of marked activity occur on the other side, both north and south of the Caribbean deep.

THE Atlantic ocean basin differs from the Pacific in that it is a relatively quiet region as regards the development of deeps, the growth of mountain chains, the activity of volcanoes, and the frequency of earthquakes. Once upon a time it was the scene of reactions similar to those that now characterize the Pacific. A zone of mountainous islands extended from Newfoundland to Georgia, similar to those of Japan, and great intrusions of molten granite, accompanied presumably by volcanic eruptions occurred there as is the case in Japan.

Great Britain was also an active country at that time. But that was long ago. The ocean bed seems to have cooled down. The modern mountain growths in the eastern United States and northern Europe, including Great Britain, are rising very slowly and broadly. The earthquakes, which average about one a year, are feeble impulses from an apparently deep source. The suggestion is that at a very considerable depth below the Atlantic, probably 100 or several hundred miles below its bottom, the temperature is slowly rising again and the Atlantic coasts may some day rival those of the Pacific in grandeur of mountain scenery and in startling incidents of Nature's activity. But we will not live to see that landscape.

A few scattered centers of earth-

quake activity occur in the Atlantic and Indian ocean basins, far from any lands, and there is one active belt that differs from the others in that it is not connected with any oceanic deep, past or present. This is the African zone. It branches from the Mediterranean belt in Palestine and extends down through east Africa to the Cape of Good Hope. It corresponds with the line of the great "Rift" valleys, which are themselves dynamic features of the continent, like inverted mountains.

Scientists have not only mapped the distribution of earthquakes, but have also kept account of the frequency with which they are occurring. Some centers react much more often than others. There is also great range in the amount of energy which may be given

United States, for example, are populous countries where even a moderately severe shock would cause an active human reaction. But the intensity and frequency of shocks around the North Atlantic is relatively so moderate in contrast to the decidedly seismic zones that the occurrences hardly enter into the census of activities of the globe as a whole.

In his "History of British Earthquakes," Davison has listed 1191 shocks as having occurred between the years 974 and 1919, practically a tremor or an earthquake every year for a thousand years. In a less populous country many of these would have passed unnoticed. In a more vigorous earthquake region even the most severe would not have been accounted as of grave importance. The great English castles and cathedrals whose strength is in good mortar and whose weakness is in their huge weight, have stood almost unharmed during the centuries.

ON the western side of the Atlantic the record is similar as regards the frequency of occurrence—about one earthquake a year in New England and Canada since the landing of the Pilgrims, but there have been several of greater severity than the English ones. It is as though we were somewhat nearer a center of activity and so experienced more emphatic impulses. Since we do not build well, since we disregard the earthquake risk both in design and construction, we will someday suffer when one of

the heavier shocks hits an eastern city. It is not the well-built skyscraper, which rests on deep foundations set on rock, but the skimped brick or weak ferro-concrete apartment or tenement house for which we should feel anxious, especially when it stands on marsh or made ground.

The earthquake anxiety exists in American communities both east and west. The lady who wrote from Massachusetts to inquire if her daughters would be safe in visiting San Francisco and the insurance men who have adopted a conservative policy in regard to earthquake insurance were prompted by a similar fear of the unknown risk.

It is sometimes to be regretted in the interest of safety that the feeling is not stronger. In Santa Barbara, for instance, only two years after the shock of 1925, there is talk of relaxing the

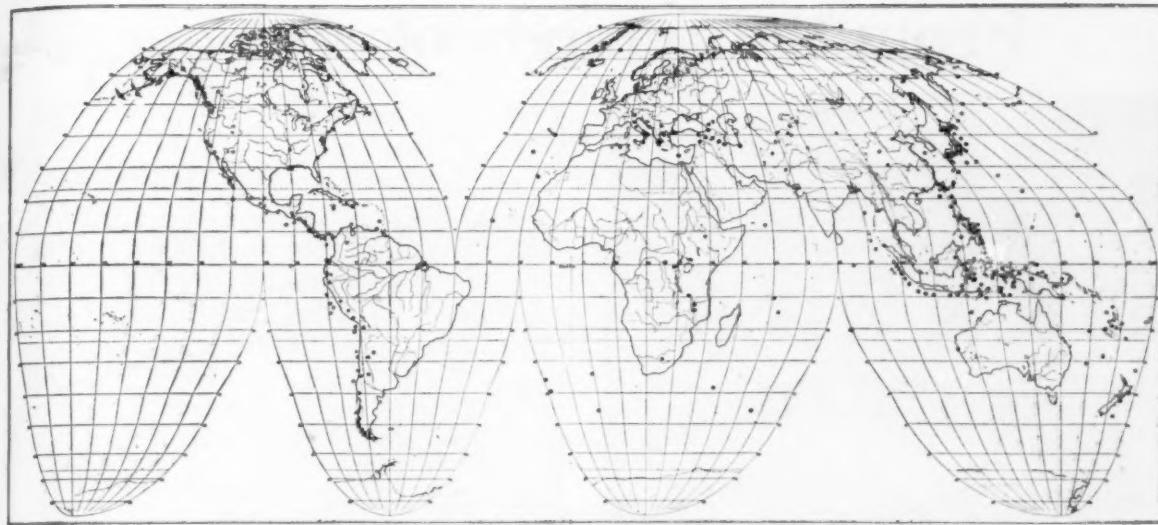


NORTH AMERICAN EARTHQUAKE CENTERS

The size of the circles indicates the relative amount of energy radiated from each point of origin of the greatest known shock from that place

off from one center or another. It is as though the intensity of the gathering force varied at the different sources, and also as though the mechanical resistances were decidedly unequal. The most complete record of these data is that which has been assembled at the German government station for earthquake investigations at Jena. Professor Sieberg of that institution has recently published a comprehensive work on earthquake lore, and from it we translate the table on page 307, which gives the frequency and roughly estimated maximum energy for a number of earthquake areas.

The table mentioned serves principally to direct attention to the more actively seismic regions of the world. There are others in which mankind is deeply interested, but which are omitted from the enumeration. Great Britain, France, and the eastern



EARTHQUAKES OCCUR WHERE MOUNTAINS ARE BEING ELEVATED

A map of the world showing the principal earthquake centers. Each dot represents a center. They are crowded where young

mountain chains are growing. The respective areas virtually coincide throughout the entire world, a significant observation

provisions of the building code adopted to safeguard the citizens of that city and their many visitors. Men's memories are sadly short, when they can find cheaper ways of doing things. Yet we can be, and some day will be, reasonably safe against earthquakes in American cities.

It has been demonstrated by the buildings that have withstood earthquake shocks in California and Japan that it is entirely practicable to design earthquake resistant structures without excessive cost. We have the materials. We know how they should be put together. Our architects and engineers can design and erect safe buildings. But so long as the laws do not require earthquake protection in the same way that they require fire protection the public will be liable to

loss of life and property whenever and wherever the Earth in its incessant activity releases an elastic strain.

An important business question is involved in the problem of earthquake insurance. There is, however, a better way to safeguard all concerned. Drop earthquake insurance as it is now underwritten and build for safety.

A STUDY of buildings which have withstood earthquakes, such as has been made by that great engineer, John R. Freeman, shows that it is entirely practicable to build safe structures and that it is good business to do so.

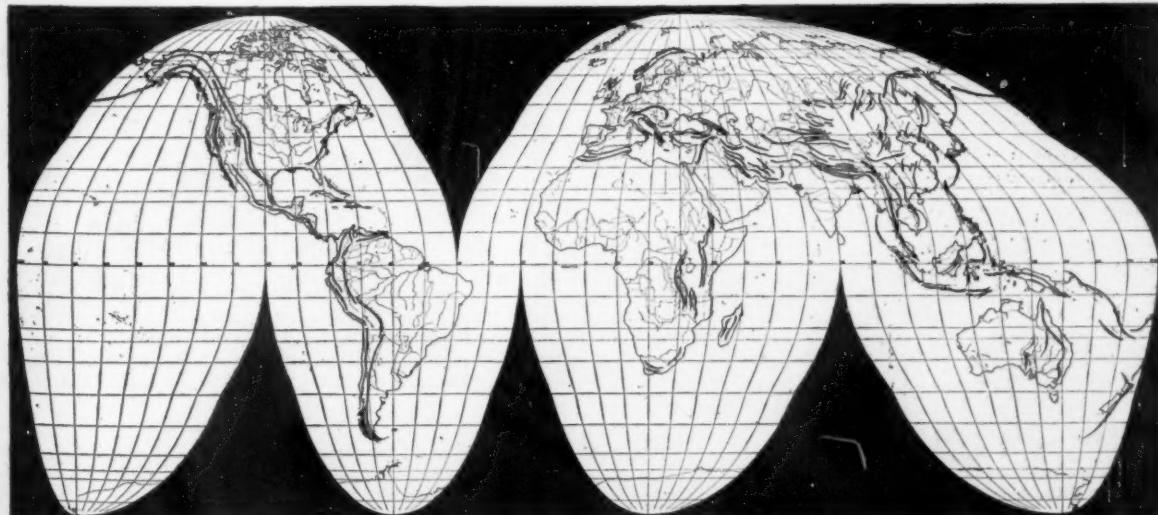
Let the banker require that any building upon which he makes a loan shall be constructed to resist a horizontal pressure calculated as equivalent to at least one tenth of its weight and

he may feel reasonably secure in his investment, so far as that particular structure is concerned.

Let a community require that its building code be amended to meet the same condition, as has been done in the Palo Alto, California, code (which has now been in use for two years without undue hardship) and the people will be safe so far as new structures are concerned.

Let owners or the public require that old buildings be examined as to their safety and be reinforced with tie rods or braced with partition walls and we shall insure ourselves against the otherwise inevitable damage.

It will be good advertising in many parts of our country to invite investigation of the assertion: "We are earthquake proof."

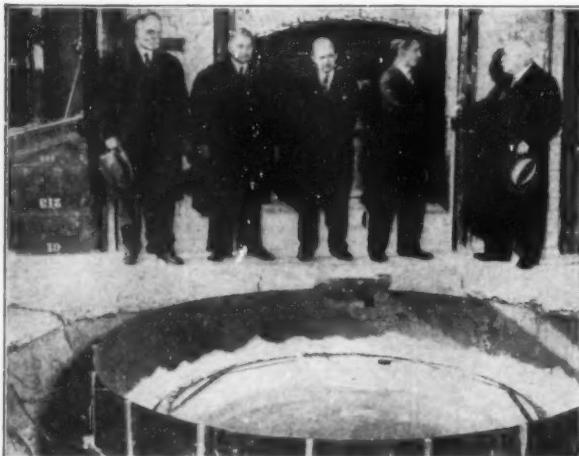


TREND LINES OF THE ACTUAL GROWING MOUNTAIN CHAINS

Broad plateaus are not included. Some ranges are growing very slowly; the Appalachians for example. Others have been raised

relatively rapidly; for example, the Sierra Nevada of California and the Himalayan. Quakes doubtless have always rocked the earth

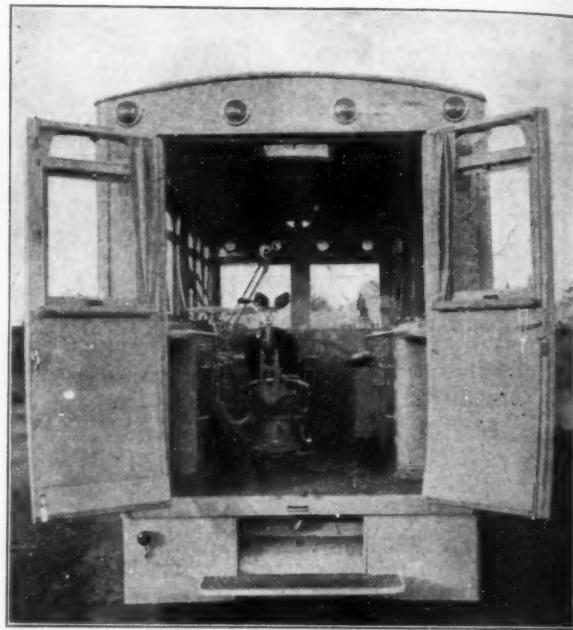
From the Scrap-book of Science—



P and A

LARGEST GLASS DISK EVER CAST IN AMERICA

The Bureau of Standards, Washington, cast this disk, 70 inches in diameter, 11 inches thick, weight 3500 pounds, in May, 1927, for the Perkins Observatory of Ohio Wesleyan University. After slow cooling to prevent strains, it was recently uncovered and found to be remarkably free from flaws. Read about it in our February issue, page 158



Herbert

TRAVELING DENTAL OFFICE

In Queensland, Australia, the country is so sparsely settled that residents must depend on such outfits as this for their dental work. These units travel many miles every year



International Newsreel

FIREMEN'S NON-INFLAMMABLE UNIFORMS

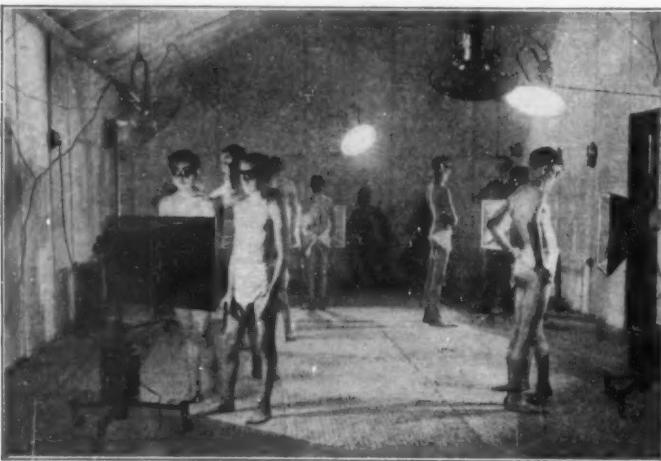
An oil company of southern California maintains specially drilled "asbestos crews" to fight oil fires. These men, in asbestos suits, imitate Mephistopheles by fearlessly walking right up to oil fires



International Newsreel

PREHISTORIC BONEYARD

A deposit of bones of the ancient sloth, uncovered in South America by the Captain Marshall Field Expedition, of the Field Museum of Natural History, Chicago. Photograph shows R. C. Thorne beside the deposit



P and A

SUNRAY BATHS

A clinic has recently been opened at a colliery in Mansfield, Notts, England, for giving healthful rays of artificial sunlight to pitboys and miners. To determine the efficacy of this treatment, 50 boys will be subjected to the rays regularly for six weeks and their condition will then be compared with that of 50 others who have not been treated. Scientists are watching the results

Camera Shots of Scientific Events

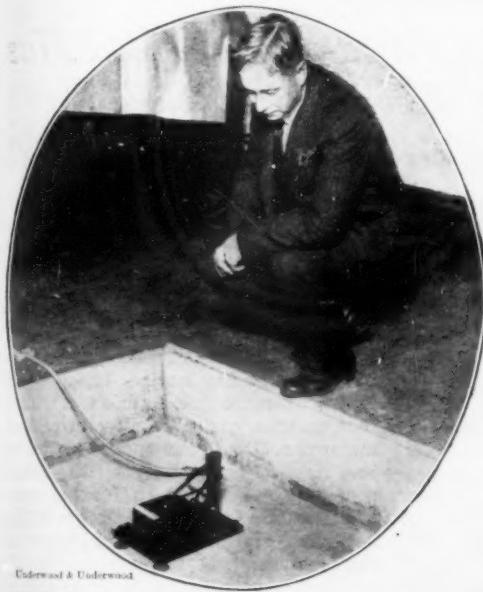
PORPOISE-LIKE ➤

The boat that made this remarkable leap at Hondon near London, England, was equipped with an outboard type motor. As the craft was driven along by a noted English sportsman, it struck a floating object, and this, combined with the force of the gale that was blowing, and its own momentum, caused the boat to jump through the air for what is estimated to be about 25 feet. One of the strangest things about it is that the photographer seemed to be prepared for it—strangest because it is hard to imagine planning it



Birrell

P. & S.



Underwood & Underwood

UNIQUE WINDMILL ➤

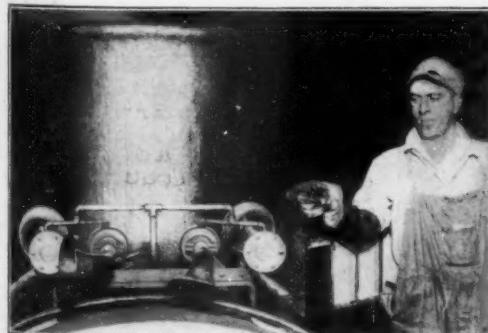
Said to be the only one of its kind in this country, this windmill on a farm near Little Valley, New York, has seen service for 40 years. The wheel is cylindrical, fills most of the cupola space, and is governed by the vertical shutters shown open in the illustration here

◀ NEW SEISMOGRAPH

This new earthquake detective developed by Dr. Frank Wenner of the Bureau of Standards, Washington, consists of a coil of wire suspended between the poles of a permanent magnet. An earth vibration generates electricity which is amplified and recorded on a paper strip



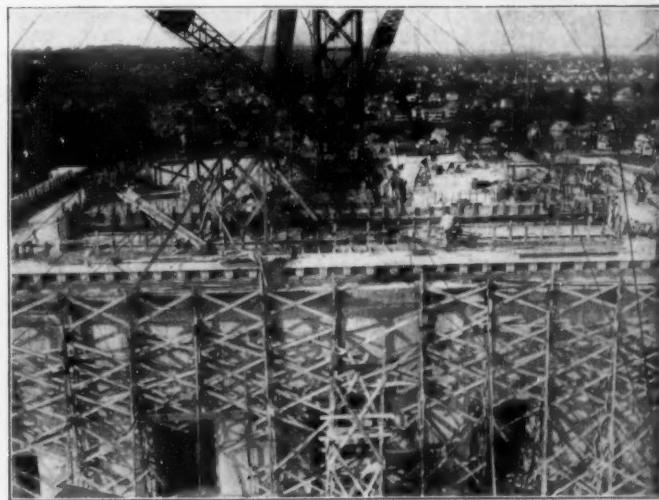
P and A



P and A

ACCIDENT PREVENTION

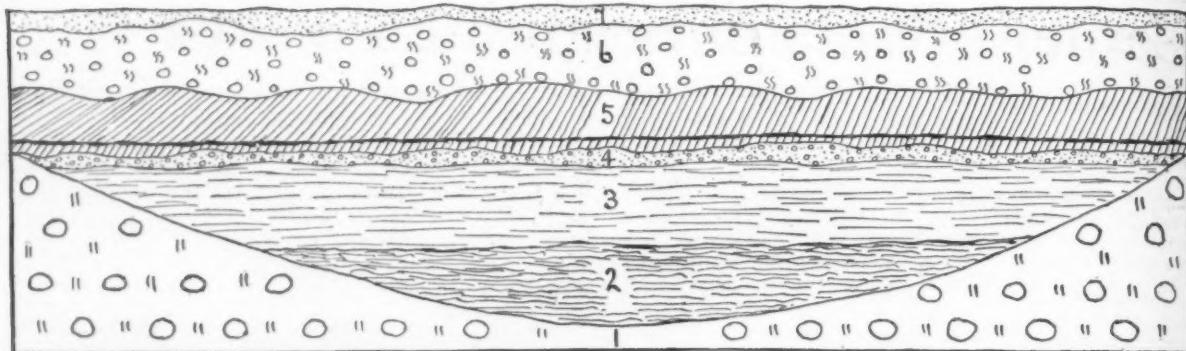
In the hope that railroad crossing accidents may be lessened by the use of the group of sirens shown here, installed on the locomotive just behind the smokestack, the Southern Pacific Railroad is now running two trains equipped with them. The tone of these is pitched lower than that of the regular locomotive whistle and their warning is said to be audible for three miles. Although operated as a unit, they point in different directions



Henry Miller

WORLD'S LARGEST CONCRETE SLAB

Three feet thick, and having a measurement of 78 by 110 feet, this roof slab of the George Washington Masonic National Memorial Temple at Alexandria, Virginia, contains 953 cubic yards of concrete. It rests on concrete beams 72 feet long and 14 feet deep, these in turn being supported by eight granite columns, 40 feet high



DIAGRAMMATIC DRAWING OF THE LACUSTRINE BEDS AT HOXNE

Figure 1: 1 is the boulder clay (intense cold); 2 is the lignite bed Acheulean implements (very cold); 5, brick-earth (temperate), the (temperate); 3 is the arctic bed (very cold); 4 is the gravel with late heavy black line in it is peat; 6, glacial deposit; 7, sandy loam

New Evidences of Ancient Man

In England the Recent Excavation of a Silted-up Lake Bed Has Revealed New and Incontestable Records of Earlier and Extinct Races of Man

By J. REID MOIR

Fellow of the Royal Anthropological Institute of Great Britain and Ireland

THERE are few places of more classic importance to students of man's past than the old-world village of Hoxne, situated in the northern part of the county of Suffolk, England. In the year 1797 there was living at or near this place a man named John Frere, who evidently took a keen and remarkably astute interest in the question of the antiquity of man. There is no doubt that then, as now, a brick field existed at Hoxne, and Frere's attention was drawn to a quantity of flaked flints which were being turned out by the workmen at a certain level below the brick-earth.

In 1797 little or nothing was known regarding ancient flint implements of any kind, and least of all about those which we now know were made by paleolithic man. Yet it is on record in a paper published by Frere that he realized fully that not only were the specimens unearthed undoubtedly examples of human workmanship, but also that the position in which they were found indicated that considerable geological changes had taken place since the makers of these instruments lived.

UNFORTUNATELY, as is sometimes the case in scientific matters, Frere's epoch-making discovery was entirely disregarded by his contemporaries, and it was not until 1859 that the English geologists, Prestwich and Evans, having become converts to the views of Boucher de Perthes regarding the implements he had found in the

valley of the Somme in France, remembered Frere's long forgotten paper and decided upon a visit to Hoxne.

Prestwich and Evans carried out diggings in the brick field, and since that time other investigations have been made by various people, and by a committee of the British Association for the Advancement of Science. The result of these researches was apparently to confirm the prevailing view among English archeologists that, so far as England was concerned, flint implements in general and those of Hoxne in particular, were of post-glacial date.

But more recently, owing to a series of discoveries in East Anglia, tending to throw serious doubt upon this long

established opinion, the British Association for the Advancement of Science once more decided to conduct investigations at Hoxne, and with the aid of a small committee of experts, I was asked to undertake the work. The excavations covered a total period of about four months, and a number of critical and important sections were exposed and discoveries made, with the result that it was possible to form a very accurate and fascinating picture of the geological and archeological history of the Hoxne site.

If reference is now made to Figure 1, it will be seen that the Hoxne beds rest in a basin-shaped hollow in glacial boulder clay. This boulder clay represents one of the deposits of the Second Glacial Period of East Anglia, and was laid down practically contemporaneously with those exposed in the sea-cliffs of eastern England. These latter accumulations were deposited by an immense ice sheet, originating in Scandinavia, which crossed what is now the North Sea and penetrated some distance into the English county of Norfolk where it left a high and imposing terminal moraine. The glacial period under consideration was without much question the most severe of the several to which England was subjected, and during its domination the country must have been denuded of both human beings and animals.

At last, however, after no doubt a prolonged lapse of time, the climate began to improve and the ice to recede



WORK PROGRESSING

The author is shown measuring the thickness of bed number 6, above the brick-earth

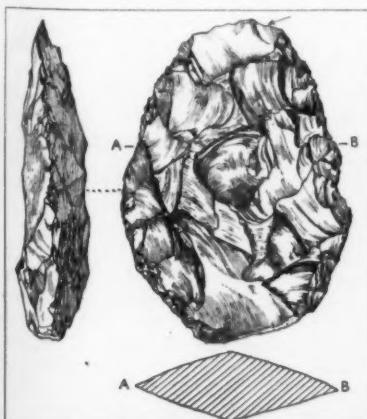
slowly. When this happened, vast quantities of water were released, and these, as they poured from the retreating glaciers, cut out many lake-like hollows in the beds which the ice had laid down during its advance. We may imagine, too, that as the temperature rose, vegetation would begin to reappear, and this would induce a northward movement of vast herds of herbivorous and other animals from the south.

The part of the history of Hoxne with which we wish to deal opens at this epoch, and we see a channel cut in the boulder clay and occupied for a period of unknown duration by a body of water in perhaps rapid movement. It is clear, however, that after a time, more or less stagnant conditions made themselves manifest in the Hoxne lake, and a process of silting up began. The result of this is shown in bed number 2 which consists of about 20 feet of lignite containing the remains of plants and other organic remains, which in their living state could have existed only in a *temperate climate*.

THUS we see that a complete climatic change is shown by a comparison of bed number 2 with bed number 1, which is composed of boulder clay laid down during a period of *intense cold*.

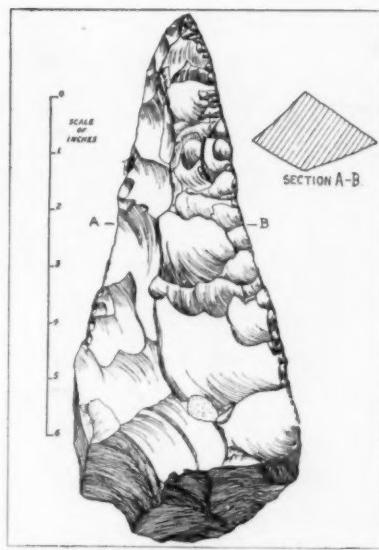
But surmounting the temperate bed number 2 is a part of a deposit in which abundant remains of the arctic willow and other plants have been found, and this affords certain evidence that the East Anglian climate had once more become *very cold*.

In beds numbers 2 and 3 no traces of man have yet been discovered, but it is otherwise in bed number 4, where a considerable number of his flint implements and flakes have been unearthed. As will be seen, bed number 4 is composed of gravel laid down by water, and this indicates that for some unknown reason, water in rapid movement was again present in the Hoxne lake. In



MOUSTERIAN HAND-AXE

Figure 3: Moustierian refers to the culture left by the familiar Neanderthal man



THE LARGE HAND-AXE

Figure 2: Referred to in text. Found in bed number 4. Age, Late Acheulean, 100,000 years ago, according to most estimates

this gravel have been found bones of the mammoth and reindeer, showing that the climate was still *very cold*. But, in spite of this, man had evidently taken up his abode on the shores of the lake and was making there flint implements of large size and of excellent workmanship.

There was little doubt that it was in the gravel of bed number 4 that Frere found his specimens in 1797, and these without question are referable to late Acheulean times, a period perhaps 100,000 years ago, and even before the days of the Neanderthal man as we know him from existing evidences. A magnificent example of a hand-axe, comparable with those discovered by Frere, was found in the gravel in 1925 (Figure 2) and other less impressive specimens of late Acheulean type, together with numerous points, scrapers and flakes, were also recovered during the recent excavations. Thus we can now locate the horizon of late Acheulean times as occurring in a bed of gravel (bed number 4) resting upon the arctic deposit (bed number 3).

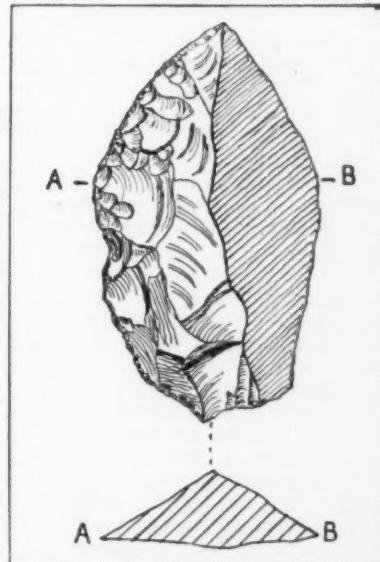
ABOVE the gravel bed is found about eight feet of the brick-earth, in reality a fine mud, indicating that the water in the Hoxne lake was again becoming sluggish in movement. Towards the base of this brick-earth (bed number 5) is a layer of peat, and intercalated with it is an ancient floor or occupation level containing abundant examples of the flint implements of early Mousterian or Neanderthal man. The hand-axes (Figure 3) of this epoch are not nearly so well made as those derived from the underlying gravel, but their form and technique are typical of the period under discussion. With these hand-axes were found *râclairs*, or

side-scarpers, points (Figure 4), knives, hammer stones, numerous flakes and some flints which by their cracked condition evidently have been subjected to fire.

With these objects occurred a fossil antler sawn with a flint knife, and it is evident that early Mousterian man must have lived at Hoxne for some considerable time. The animal bones found with the Mousterian flints are the forest horse (very large), the red deer and European beaver, which point to the prevalence of a temperate climate at this period, while the plant remains in the peat with which the floor is intercalated point clearly to the same conclusion.

THE Hoxne lake was now almost completely filled up, and the brick-earth represents the final stage in the process.

We do not know for how long conditions remained unchanged after the lake had ceased to exist, but the deposit covering the brick-earth indicates that the climate of East Anglia had changed yet once again and became *intensely cold*. For there can be no doubt that the brick-earth is



A POINT, BED NO. 5

Figure 4: Note the fine chipping along the edge and the peculiar cross section A-B

covered with a bed (bed number 6) laid down by ice during the third glacial period of eastern England. In this deposit are found examples of striated and abraded flint implements referable to various epochs predating the Third Glacial stage. Above the ice-laid accumulation are certain sands and sandy loams (bed number 7), which may have been deposited by aeolian or wind-blown agency, and which contain flint implements of flakes of probably upper paleolithic age.



FROM A CHARCOAL DRAWING, BY HUGH FERRIS, OF THE MITSUI BANK BUILDING

Japanese Bank Defies Attack

The Ten-Million-Dollar Mitsui Building in Tokio Is a Veritable Man-Built Gibraltar

By HOWARD McLELLAN

ON a square in the heart of Tokio a toiling army of Japanese workers, generalized by American engineers, are warping into place huge blocks of granite. A few years ago the ground now buried beneath tons of steel and stone was strewn with the ashes of ancient buildings leveled by the sweep of fire which came in the wake of an earthquake.

These Nippon workmen bend to their tasks with patriotic devotion, hurrying faster than they would at an ordinary building task. And why not? They are raising a monument to the House of Mitsui, the first of the great Japanese banking families upon whose far-flung enterprises the sun never sets and who have woven into their banking and industrial activities the precepts of an ancient religion and time-honored family customs dating back 14 centuries.

In this zeal they reflect a sort of reverential admiration for a family whose name stands as a symbol for unmeasured power in international trade and finance. In the counting houses of the world it is said of the family:

"Ah, yes, Mitsui—when you mention Mitsui you are speaking of Japan, for Mitsui is Japan."

There is hardly another way of gagging the size and power of Mitsui inter-

ests unless, as frequently happens among those who know Mitsui best, they are spoken of as "Morgan, Rockefeller, and Ford all rolled into one."

But it is not the size of the Mitsui enterprise nor the family wealth nor the classic beauty and magnitude of the building which this army of native toilers is erecting that attracts the interest of engineers and bankers the world over. The outstanding importance of the structure is that it represents the triumph of engineering over the destructive elements of nature and the attacks of predacious criminals. Here, its builders say, is a banking structure that is impervious to earthquake, fire, and flood or against the attack of burglars, bandits, or mobs.

ASKED to describe its impregnability, a representative of Trowbridge and Livingston, the American architects who are building it, said:

"The Mitsui building is the last word in formidable bank construction. If it were possible to stand it on end, the skeleton construction is of sufficient strength to withstand the strain. If it were possible to move it into the sea it would remain intact. Against fire it will prove impervious and it cannot be attacked successfully by mob or bandits. It has been built to move as a

unit, and primarily to resist earthquakes."

In the earthquake of 1923 the old Mitsui building was destroyed, hence the determination of the concern to invest 10,000,000 dollars in a new building that would preclude destruction by the force of earth tremors. The earthquake problem was put up to Samuel C. Weiskopf, senior member of the American engineering firm of Weiskopf and Pickworth. Although the requirements called for a radical departure from accepted methods of construction, Mr. Weiskopf, in collaboration with the architects, devised a form that met with the approval of the Mitsui directors and their experts. Months of research both in Japan and America were necessary before the new form was finally adopted, and the contract to build given to James Stewart and Company of New York.

The new building is an imposing and dignified structure. Its length stretches a full block of 360 feet so that three sides face on streets. The architectural treatment consists of a row of granite Corinthian columns extending to the third floor, flanked on the end bays, on each side, by substantial pylons. The entire area of the first floor is devoted to a great open banking room 41 feet from floor to ceiling, through which are

extended slender marble columns. Four floors above the banking room are devoted to offices for the various Mitsui organizations.

The important features in the construction of the bank can best be covered by treating each stage in the order of its building. To make the foundation impervious not only to earthquake but to the action of water—the site of the building is but a short distance from the sea—a thick concrete "pan" was sunk into the earth. A four-foot "mat" or floor of reinforced concrete was laid 20 feet below water level and each of the four sides of the "pan" were built up to the earth's surface.

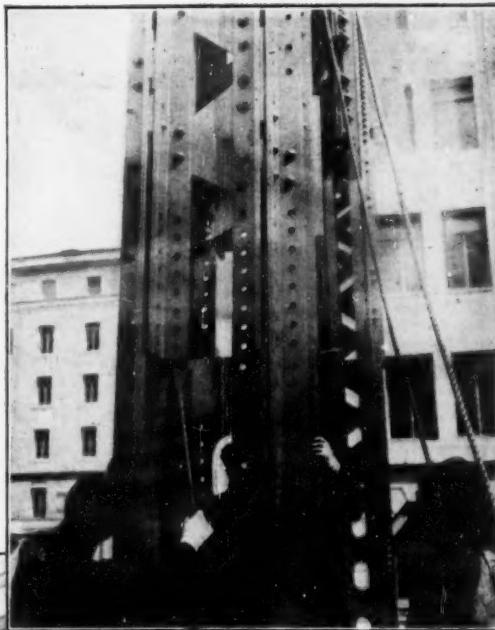
THE "mat" was a construction feat of some proportions. It was poured in 70 sections of 800 square feet at a time and, in addition, its exterior surface, which rests upon the earth, was beveled to minimize, or deflect, earthquake shock by eliminating sharp protuberances. The entire "pan" forms a monolithic casing, or cradle, a unit by itself, designed to distribute evenly to the steel structure any shock. It is the first line of defense against subterranean tremor and it will also successfully resist any attempt at tunneling.

To this mat are anchored the specially designed steel columns. It was necessary to go well outside the range of current engineering practice to devise these columns and also develop an entirely new form of steel girders and splicing to meet the distortion and bending movement peculiar to earthquake action. Explaining these features of the

construction the engineers say:

"Since a lateral force of one tenth the weight of the super-incumbent parts of a structure would produce very severe bending actions, flexural strength of all the members obviously was a controlling feature of the design. The large tensile forces developed by bending and the reversal of stress occurring in earthquake vibrations dictated the suitability of a structural steel frame."

"Consideration of the distribution of bending stresses in a steel frame tier building, when these bending stresses are large compared with the vertical



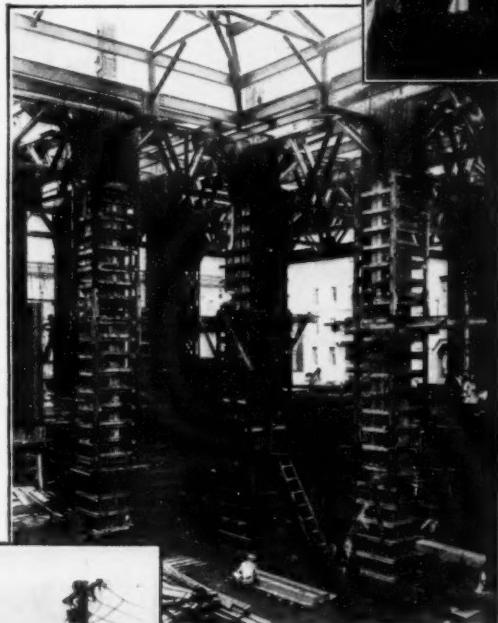
TELESCOPIC SPLICING

This method of construction of the great steel columns is one of the secrets of the solidarity of the bank building described

manner in which the members of the frame were proportioned. Columns splices are at midstory, the point of contraflexure, and this is a radical departure from the usual order.

ONE special requirement of the Tokio building laws that is framed with a view to providing maximum earthquake resistance is that in splices in columns, the abutting surfaces shall not be considered as transferring load but that a riveted splice of sufficient strength to carry the entire stress shall be supplied. So far as this requirement has been met heretofore it has been done by putting outside splice plates at column joints, piling up these plates to the thickness necessary to provide sufficient area and extending them a long distance each side of the splice in order to provide sufficient rivets to develop them. This form of splice is very cumbersome and of little practical value as a protection against shocks. The Mitsui column lends itself admirably to a riveted splice.

The splice plates are placed in the four planes of the column lacing, all the splicing rivets being in double shear. The first splice in all the large columns is located at the point of contraflexure between the first and second floors. Although theoretically no bending stress would have to be transferred at this point, nevertheless, by splicing the column angles at staggered points, the

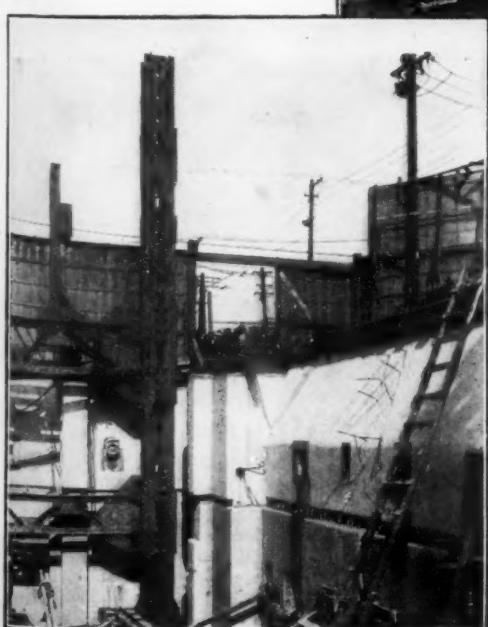


CONCRETE

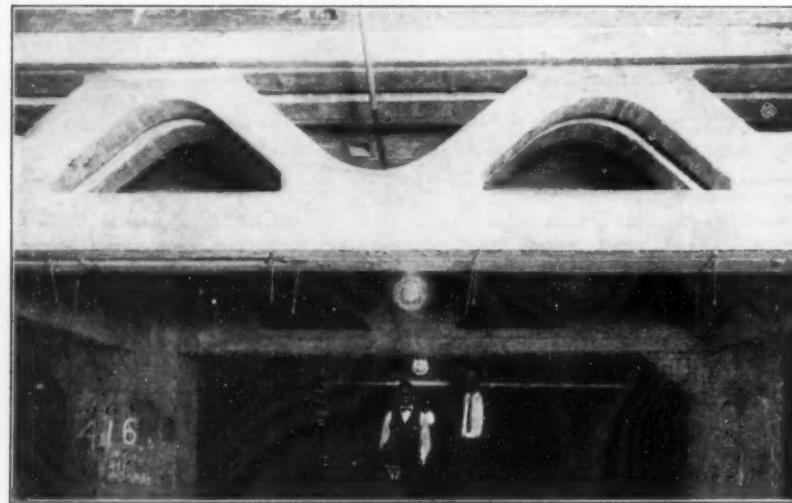
Wooden forms surround the steel columns, and into them, concrete is to be poured. The granite and marble facings will rest against these concrete masses

THE "PAN"

A section of the cradle into which the building proper will fit. The column marks one of the building's corners



loads, suggests the typical proportioning of the members of the framework for strength should represent a strength distribution along cellular lines. The members then should be heaviest at the junction of column to girder where the connection itself is subjected to the maximum moment, becoming more slender toward mid-length. This is the



IN THE BASEMENT OF THE BUILDING

Part of the massive concrete shell which forms a separate line of defense against earthquake, flood, and fire, and which will resist all attempts of burglars

full value of the column was developed. The upper splices were designed in a similar manner, the loads being of course much smaller. Between the second and third floors the splice was again located at the point of contraflexure, but in the fourth story the bending moment was sufficiently small to place it a short distance above the floor line."

The steel skeleton forms the strongest line of defense. The entire skeleton is covered with heavy thicknesses of reinforced concrete so cast and joined that a shell of cement, stone and steel, practically one huge casting, offers another defense not only against earthquake but against fire or human violence. The use of concrete in this manner makes possible the statement that if the building were turned upside down, or on end, it would remain intact.

ANOTHER feat in engineering, hitherto unknown in bank building, is the manner in which the massive granite columns which grace the exterior of the building have been built. Instead of resting the granite against the inner steel columns, another layer of concrete has been imposed between granite and steel, thus creating a still more formidable element of resistance. The use of bronze and copper for windows, copings, cornices, and doors throughout again multiplies the resistance to bandit and mob attack as well as earthquake and fire.

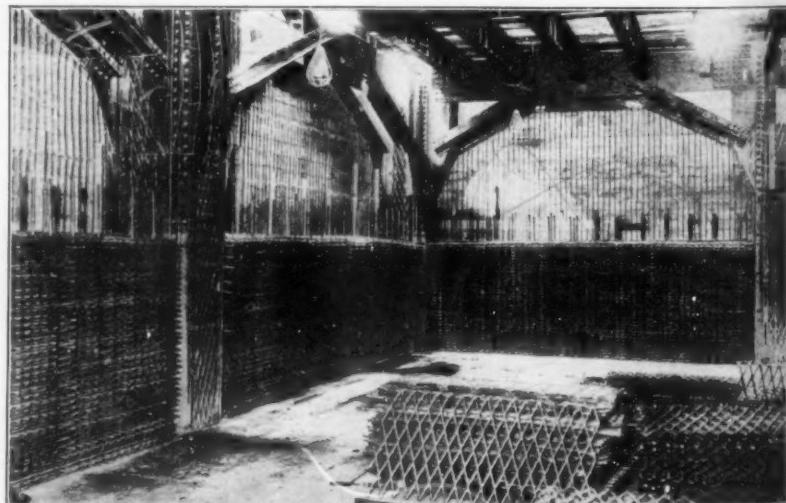
All windows, doors, and sky-lights are equipped with what the Mitsui engineers describe as the heaviest and most elaborate fire-shutter system ever installed in a commercial building. While designed to resist fire, this system will also ward off attack by flood or mob. In the event of such attack, the shutters may be controlled manu-

ally or electrically, not only from various parts of the banking room but from remote-control stations throughout the building, even from two penthouses on the roof, which house auxiliary fire pumps and elevator machinery. In the event of fire, the shutters close automatically. In many respects the shutter system resembles the bulkhead system on modern unsinkable steamships.

AFURTHER protection against fire is provided by an auxiliary gasoline engine plant which operates pumps, an independent electric lighting system and an emergency elevator. Installed primarily as a fire-fighting agency, this system will provide light and a means of inter-communication within the bank should a mob attack it and the staff of the in-

stitution be compelled to remain within the building, cut off from outside help. An artesian well sunk under the foundation mat will supply the water. A reserve supply will be kept in huge armorplated storage tanks in the sub-basement. Kitchens, dining rooms, and space for living quarters are also provided for in the plans so that if earthquake, fire or flood again visits destruction upon Tokio, the human element in the Mitsui bank may be isolated but they will be able to continue to function.

IN the effete west, we are prone to believe that our banking institutions contain the last word in 100 percent burglar and bandit proof vaults. The big vaults in some of our American banks present a formidable argument against bandit attack, but it is said that the new Mitsui vaults, when completed, will exceed in their impregnability anything heretofore conceived. There are seven such vaults in the Mitsui building, in which will be guarded some 250,000,000 dollars of deposits, tons of important bank papers and securities, and the valuables of thousands of safety deposit box holders. The safety deposit vaults are in the main basement and are said to be the largest ever built. The trust company and bank vaults are on the main floor, while four other storage vaults are in the basement. The walls of each are of special construction of reinforced concrete and steel, 30 inches thick. In addition to the usual reinforcing strips of steel used in concrete, there are layers of steel webbing. A net work of copper wires has also been built into the walls in such a manner that upon slightest penetration of the wall surface, from within or without the vaults, alarms will be sounded throughout the building and in nearby police stations.



WEB CONSTRUCTION OF WALLS OF VAULTS

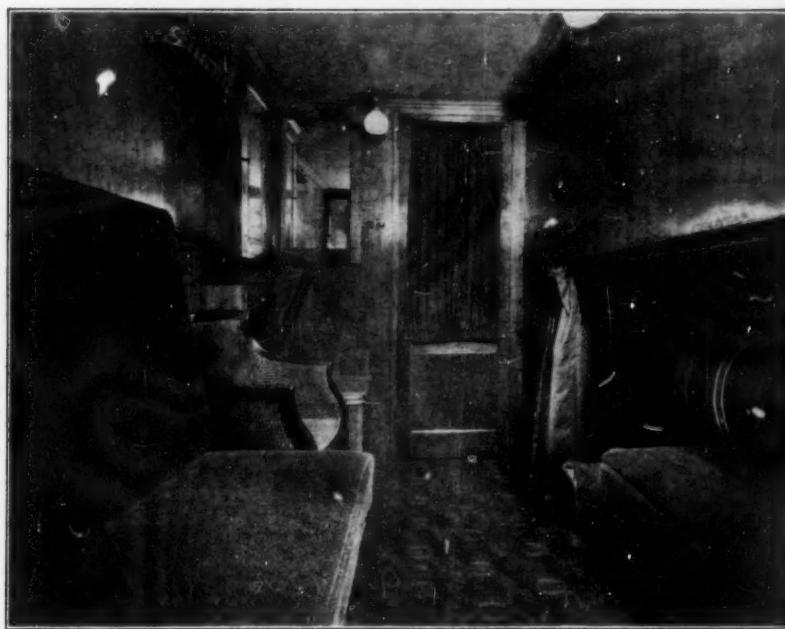
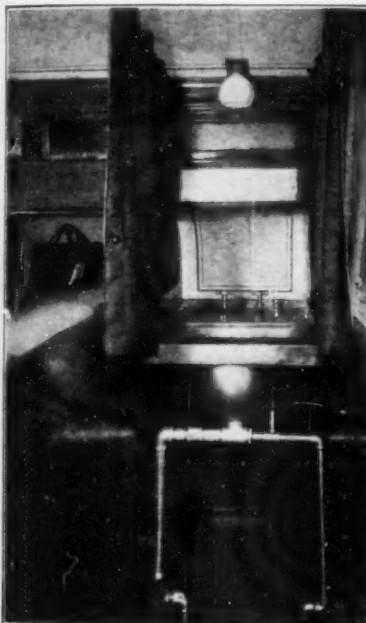
Tons of steel webbing were used for this construction. In addition, miles of copper wire were interlaced through this webbing and connected to alarm signals

Comfort In Sleeping Cars

New Design Conserves Space, Is Economical In Operation, and Provides Privacy for Passengers

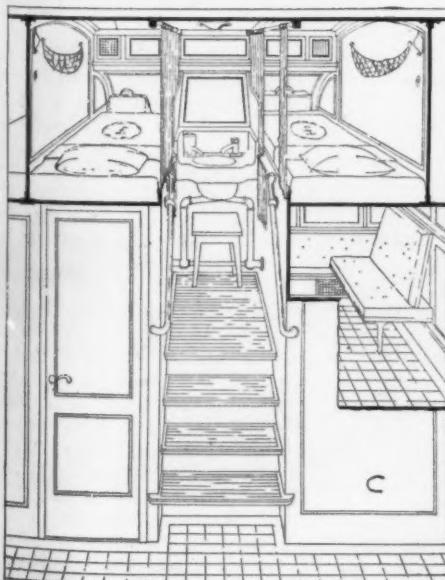
MAIN ROOM

On this page are shown several views and a cross-section drawing of a new type of sleeping car developed by Ernest Flagg, well-known architect and inventor. The main object of the design is comfort with no increased cost. The latter consideration is met by the conservation of space and by utilizing space that is wasted in the ordinary sleeper. Each compartment of the new car contains a main room with double berth, shown at the right, and duplex berths.



DUPLEX BERTHS

The platform (see drawing below) is about four feet above the floor level. On either side is a berth, with space for storing baggage. Between the berths, and screened from the view of the occupants of either, is a combination lavatory. Above this is a mirror and convenient light. At the end of the duplex platform is a curtain, not shown, which makes for greater privacy, and prevents people passing along the public corridor from seeing into the occupied berths.



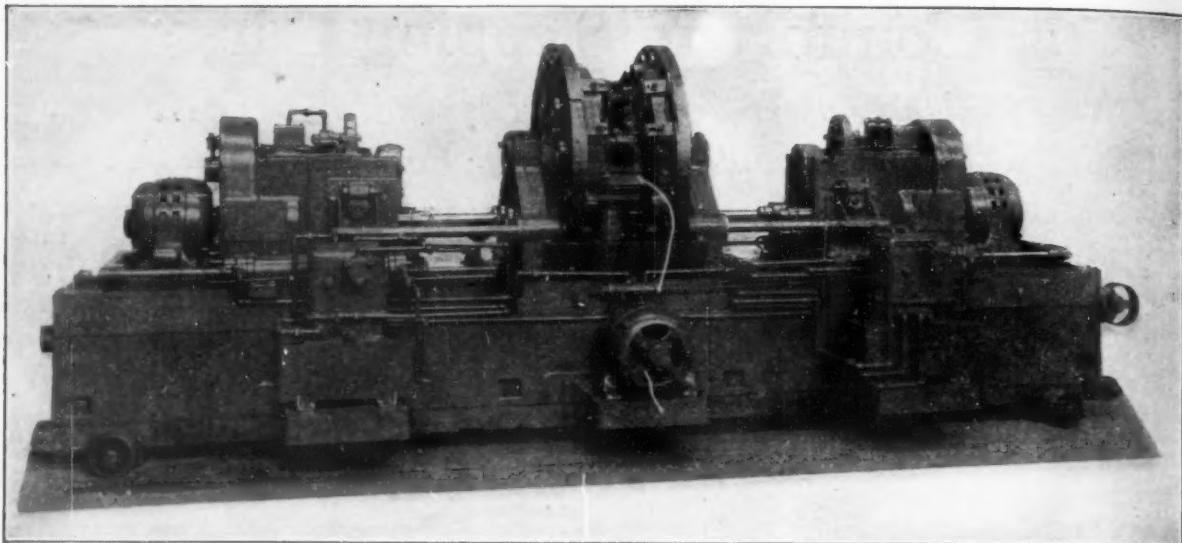
SKELETON VIEW

This cut-away view from the corridor gives a good idea of the general arrangement of one entire section, consisting of a main-floor room with large double bed, and the duplex berths above. It will be observed that use is made of the hitherto wasted space under the roof of the car, without undue crowding or cutting too much the head-room of passengers either in the lower room or the duplex berths. The car itself will be the standard Pullman length with the corridor along one wall near the windows. Although each room and duplex unit will have its own plumbing, there will be at one end of the car a toilet for men and at the other a toilet for women. During the day, persons in the rooms may draw the curtains and have complete privacy, as shown in the upper right-hand picture. At one end of the car there is a large "day room," or lounge in which passengers may sit, as in an ordinary parlor car.



CORRIDOR ENTRANCES

Mr. Flagg's arrangement allows for seven double-bed rooms and 16 single berths in pairs. Besides giving more berth space than standard Pullman cars, his design insures greater comfort and privacy for passengers. The three photographs on this page illustrate the model that has been built by the Canadian National Railways.



Courtesy Baker Brothers, Inc.

SPECIAL HYDRAULIC-FEED BORING MACHINE

For simultaneously boring and drilling the idler shaft, countershaft, and main-shaft bores in transmission cases, two at a time. Each head

has individual motor drive and oilgear feed. It is entirely automatic except for chucking and engaging feed, which is done with foot pedal

Hydraulic Control of Machine Tools

Perfected System is Economical, Reliable, Simple in Operation, and is Claimed to Reduce Fatigue of the Workman

SEVERAL years ago, hydraulic control was applied to broaching machines and proved so successful that it has been rapidly developed and adapted to many standard machine tools. The low maintenance cost of this system, its flexibility of control, and high production capacity as shown by the success of the first application, brought it forcibly to the attention of the manufacturers of grinding and drilling machines and these were, in turn, hydraulically equipped. Following this, came the development of hydraulically controlled lathes, chucking machines, and milling machines. The advantages of hydraulic control are so multitudinous, it is claimed, as to give promise of a much greater application in the future.

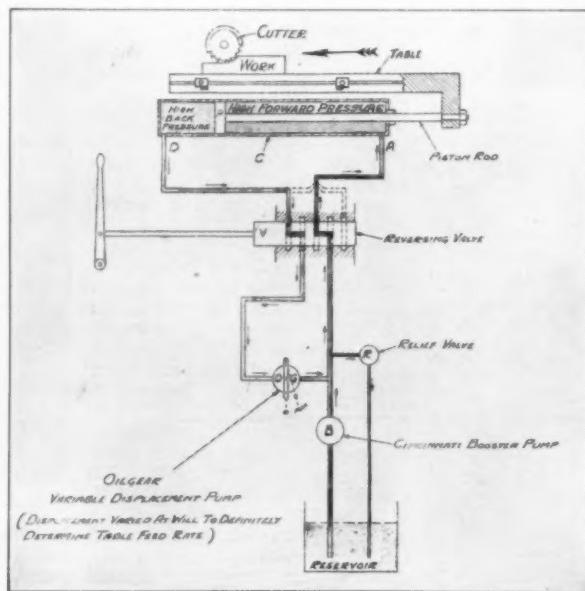
IN principle, the system is quite simple—far more so than that of mechanical control, in which there is a multiplicity of gears and parts. Basically, the hydraulic feed consists of an oil pump, an oil piping system, a cylinder rigidly attached to the machine frame, and a piston attached to the carriage or table. When the oil pump is

started, the pressure of the flowing oil exerts force against the piston which carries the table along with it as it moves. Other hydraulic controls are similar in operation and as simple.

In practice, however, there are many engineering problems involved in the

adaptation, due to the many types of machines and the complex characteristics of each. On some, the piping system must be very elaborate, or perhaps the control valves need special designing, or again it may be necessary to have a number of driving pumps on one machine. Some machines work best with a variable-delivery pump, while the speed of others is governed by choke valves inserted in the pipe lines. In the former case, the rate of the movement is regulated by setting the pump for a predetermined speed so as to give a certain oil flow against the piston head. In the latter, the choke valve is set to allow a certain flow, the pump speed remaining constant and the excess pressure of oil being taken care of by a relief valve.

DEPENDING on the type of machine and the nature of the work it does, a high-pressure or a low-pressure system is used. Low pressures have been used on machines where comparatively little force is required, while the pump on a recently built, heavy machine has a delivery capacity of 3060 cubic inches per minute at a

**HYDRAULIC FEED PRINCIPLE**

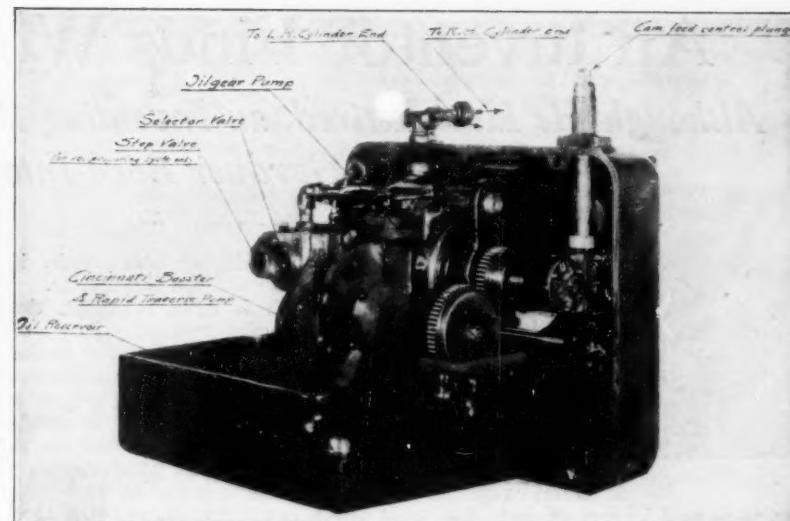
The system shown here utilizes a variable delivery pump for regulating the rate of flow of oil against the piston. The piston, moved horizontally by pressure of oil from the pump, carries the table as it moves

pressure of 1000 pounds per square inch.

Often it is desirable for the feed rate to be low as the cutter enters the work so that the shock of contact will not lift the work out of the fixture or vise. It is impracticable manually or mechanically to change the rate of feed after the cutter has entered the work, whereas it is easily done hydraulically since this system has an infinite range of speed variance from zero to maximum cutter capacity. This flexibility makes work possible on material on which it is desired to make a fine cut over certain sections and a much heavier one over others. The table speed of a hydraulic feed machine can be varied by increments throughout the full range, while with the mechanical feed, all depends on the gear ratio and its definite steps.

OBVIOUSLY, the complete arrangement gives a definite rate of feed proportional to the metered discharge of the pump, less leakage from the closed pressure side of the circuit through the pump pistons and the feed piston. It will also be clear that the rate of movement of the piston will never exceed that corresponding to the predetermined and fixed discharge of the pump. Greater or less resistance to the piston's movement—caused by the difficulty of the cut—will only change the pressure of the oil in the cylinder without materially affecting the volume of oil that flows, or its rate of movement.

The advantages claimed for hydraulic operation may be listed as follows: (1) Speed control flexibility; (2) Higher cutting speeds; (3) Saving of cutting tools, especially in heavy drilling operations, since the tool does not break through at the end of the operation where, in mechanical drives, there is bound to be an accumulation of backlash from the gearing; (4) Straight



Courtesy Cincinnati Milling Machine Company

THE POWER UNIT OF A HYDRAULIC CONTROL

Concentrated within this space are both the variable delivery pump and the booster pump which for the sake of simplicity, are shown separate in the schematic diagram on opposite page

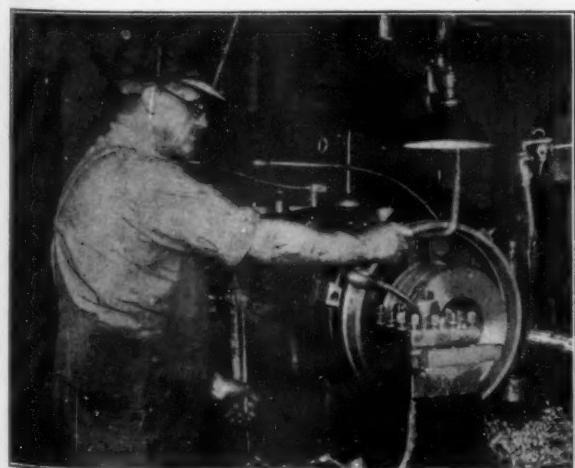
line or rotary transmission of power; (5) Quietness; (6) Quick reversal of feed with practically no shock; (7) Simple and positive control, both hand and automatic, of all rapid-traversing, feeding, and reversing movements; (8) "Slip," which permits movement to slow up when tool is overloaded—allowed by both the relief valve and the cushioning effect of the oil—without the "windup" that occurs in the gearing of mechanical feeds; (9) Fewer moving parts; (10) Reliability and low upkeep cost due to the small number of wearing parts, and (11) Readily controlled acceleration or deceleration of feed during a cut.

As applied to chucking—where the movement is rotary—one manufacturer claims these advantages for hydraulic control: (1) Saving of operator fatigue; (2) Uniformity of gripping; (3) Greater speed than in manually oper-

ated chucking, with less operator effort; (4) No distortions of light work of large diameter since jaw pressure can be reduced, and (5) Release of pressure in cylinder once the jaws are closed.

Perhaps the outstanding advantage claimed for this hydraulic system of power transmission is its sensitiveness to control and the ease with which it is operated with such slight operator effort.

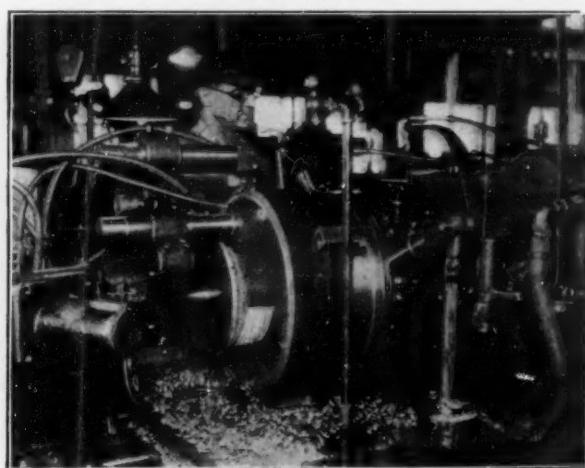
THE effect of the development of hydraulic control for machine tools, on the industry as a whole will be reflected in the near future, it is claimed, in a much wider application of this system to many new machines with a consequent increased speed of production, greater profits for the manufacturer, and lower prices for consumers of machined steel all along the line.



Courtesy Foster Machine Company

HYDRAULICALLY OPERATED CHUCK

Universal turret lathe for turning cast-steel chuck bodies, equipped with hydraulically operated chuck. It can use water, oil, or air



ITS OPERATING PISTON

The vertical rod toward the right of this picture is the piston that operates the jaws of the chuck, giving, it is claimed, a powerful grip

An Inventor Finds Work Is Play

*Although He Had Retired, an Inventing Problem to be Solved
Lured Percy Gardner Back Into Business*

By MILTON WRIGHT



Percy Gardner

If you happen to be in some branch of textile business you are, of course, familiar with the name of Percy Gardner. For 40 years he has been one of the best known men in the industry—salesman, inventor, manufacturer—so well known, in fact, that a group of men recently organized a corporation called the Percy Gardner Company and made goods which they boasted were "Percy Gardner quality," although the Percy Gardner about whom we are speaking had nothing whatever to do with the organization.

Or perhaps you happen to be something of a billiard player. In that case, also, the name of Percy Gardner may be familiar to you. In the billiard world he has been such an outstanding amateur that we told him we were going to talk about it in the article which you now are reading.

"Don't do it!" he protested.

"Why not?" we asked. "There is a lot we could say, isn't there?"

"Never mind whether there is or not. We won't discuss it. I'd much rather talk about textiles."

THAT being so, we promised not to talk about it. Also, we promised not to discuss the times he competed in world's championship skating matches, or his golfing activities. Having promised, we won't go into these things, although we would like to mention them by way of leading up to the most important of his many inventions—bias cloth without seams.

But what have his activities in the field of sport to do with his inventions in the textile field, you ask. Just this: he could always use his hands and feet expertly, a faculty too often overlooked by those who would be successful inventors. There is some connection to be found, too, between studying angles on green felt and his devising

means of producing bias cloth, if we wanted to analyze the matter.

Bias cloth is cloth in which the threads run criss-cross at an angle of 45 degrees to the edge of the goods. In other fabrics the warp runs lengthwise, with the weft at right angles to it. Take an ordinary piece of goods and try to stretch it either lengthwise or across. It won't stretch. Now take it by the two corners and pull. It stretches readily. There you have the virtue of bias cloth. It can be stretched into any desired shape and folded on a curve, so that it will fit neatly in any position in which it is placed. If the Army had only issued bias-cut puttees to doughboys during the War there would have been 10 percent less profanity in the A. E. F.

Bias cloth is used more widely than most people realize. Every man has yards of it in a suit of clothes. There is plenty of it in every pair of shoes; soft athletic shoes, or "sneakers" especially, each sneaker using about a yard of bias tape. The under side of

every soft collar is lined with it. Housewives use it in the home extensively, which explains the fact that one chain store organization bought a million dozen pieces of bias tape last year. In the electrical field, vast quantities of bias cloth impregnated with varnish are used. One of the biggest corporations in America is making imitation leather of it and now is using it for automobile tops. Rubber companies use it, textile companies—the list could be extended almost indefinitely.

"How did you come to be an inventor?" we asked Mr. Gardner. "Did you work as a boy in a machine shop?"

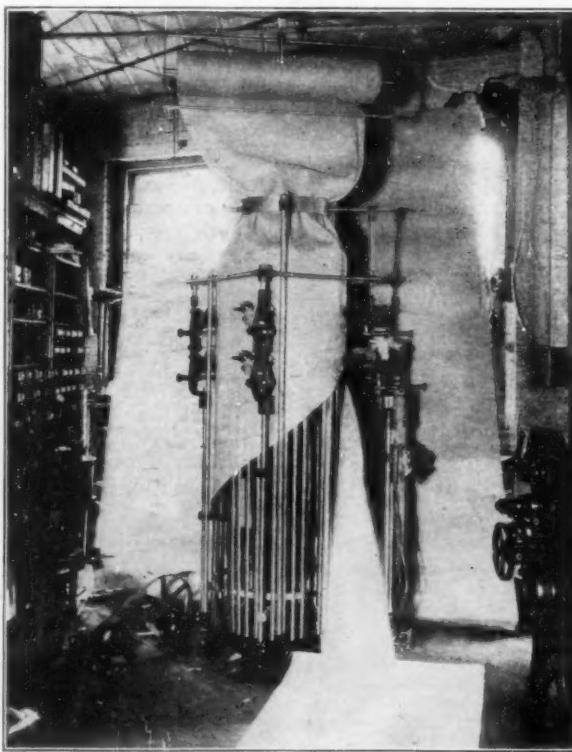
"No," he replied. "As a boy I was a singer. I sang in church choirs and took feminine roles in musical comedies. This went on until I was 17 years old, when I entered a technical school and learned the fundamentals of weaving. I have spent my life in the textile industry; I have done about everything in it—office work, working at looms, selling, inventing, manufacturing. All my inventions have had to do with the textile business. Every inventor, I think, ought to stick to the line with which he is most familiar."

"How many patents have you taken out?"

"I COULDN'T say—probably somewhere between a dozen and twenty. Many of the inventions I have never patented; they have been little improvements we have used in our own plants to enable us to make our goods better or more cheaply. I probably have devised a thousand new attachments or parts for machinery."

"Did all your patented inventions have to do with machinery?"

"Oh, no. Remember that I have been interested primarily in selling my goods in preference to the goods of other people. Sometimes this could be accomplished in one way, sometimes in another. To this end I have patented packages and containers, methods of packing, devices for display in retail stores



CUTTING A SHEET OF BIAS CLOTH

The stationary emery wheel at the right center cuts the cloth as the form revolves, carrying the specially formed tube of material

and the like. I never go into the notion department of a dry-goods store without seeing some of my inventions. Especially when I was traveling up and down the Mississippi River selling my goods would I see opportunities which would enable me to supply customers with things nobody else could supply. Wherever there is an opportunity to give people something they will want, that they can not get elsewhere, there is opportunity for profitable invention.

"One of my inventions was a container for ribbons which would enable a woman in the home to pull out just the length she wanted, leaving the rest of the roll inside where it was protected from dust and wrinkling. Any excess ribbon she happened to pull out could readily be put back on the roll by a simple movement of the thumb."

ANOTHER of Gardner's inventions was a device for throwing, by a positive motion, leno threads over the warp ends of cloth in process of weaving. Previously the throwing had been done by a positive-negative motion. This enables him to make thousands of patterns which otherwise would have been impossible. Another invention was a device for making feather-stitch braid. He, in fact, made the first piece of feather-stitch braid ever manufactured in this country. It is braid with patterns. There have been immense profits in it, although the vogue for feather-stitch braid has dwindled considerably. They sold a hundred million pieces of it in one year.

Another invention was a process for making a *sticherei* edge. (*Sticherei* is the German name for embroidery.) *Sticherei* braid before that time was the leading industry of the city of Barmen in Saxony. A Saxon loom produced 120 picks a minute. When Gardner evolved his machine, which ran 3000 picks a minute, producing a braid identical with the Saxon article, importations from Saxony ceased and the Barmen mills were driven from a market they never have been able to regain.

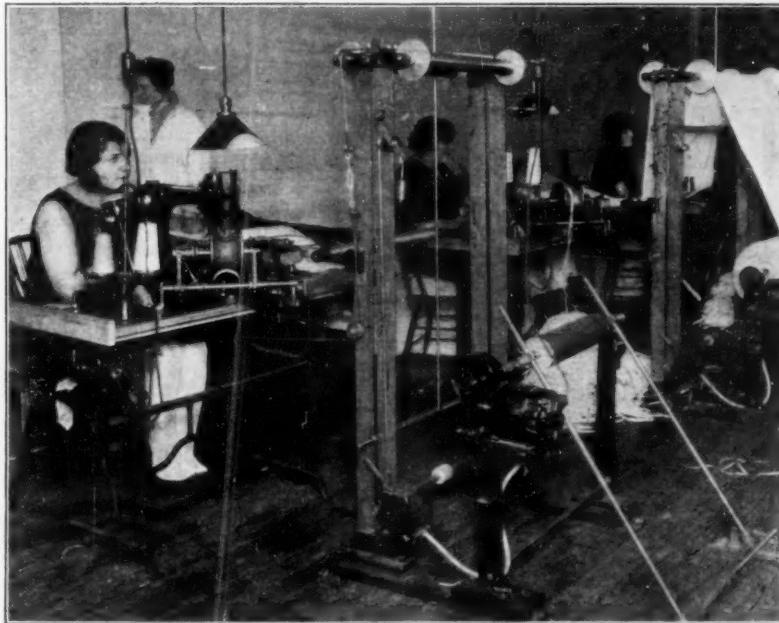
"How did you come to invent the method making bias cloth?" we asked.

"Let me set you straight at this point. The credit for that invention belongs to Horace M. Bunker, rather than to me. Before any invention is worked out, you know, somebody must get the idea that it ought to be done. That man is the *real* inventor. Bunker was the man with the idea; I was merely the man who worked out a way of doing it.

"I had retired from business, when one day Bunker came to me and asked me to make a machine that would produce bias cloth. He seemed to take it for granted that I could do it.

I had never met him before but I had heard of him; he was vice-president of a cotton goods commission house at the time. He saw a big market in the electrical field for cotton goods impregnated with varnish and he wanted to promote sales there. I

the seam apart and press them back flat. Ours is the only machine, by the way, which can open up seams. I invented it lying in bed. I was folding a handkerchief around my fingers when the solution came to me—a little offset guide—which is the



WHERE THE CLOTH TUBE IS FORMED

Before the material is cut on the bias, as shown on the opposite page, it is formed on a specially designed sewing machine—the only one that can sew and spread a seam

believe nothing is impossible in the mechanical line, and I told him I thought I could devise the machinery needed. Bunker suggested a partnership and I got back into harness again."

"How long did it take you to perfect your machinery?"

"Machinery, as I see it, is never perfected. In about one year we had a machine that would give fairly good production, but it took about three years to develop it to a point where we were satisfied. This development work cost us about 40,000 dollars. We were able to reduce the manufacturing expense of bias cloth to one fourth of what it was by the previous hand method, and the number of persons working on a bolt from six to one.

LEAT me explain bias cloth. In an ordinary piece of cloth you have the warp threads running lengthwise and the weft across, with a selvage along each edge. To make bias cloth by the old hand-method they used to cut the cloth across at a 45-degree angle, making diamond shaped pieces, and then turn these pieces around and stitch them together again.

"With our method we make the cloth into a tube by running it through a sewing machine which forms a seam. We then spread the edges of

secret of the machine's success. The solution to many an inventor's problem, I think, comes to him while he is lying in bed thinking about them.

"Having opened the seams, we roll the cloth back into a tube roll again, and lastly we place the tube over a revolving cylinder where a stationary emery wheel, held at an angle of 45 degrees, slits the tube spirally. The result is a continuous straight piece of goods 120 feet long with a bias weave."

"How do you make money out of this invention—by selling the bias cloth or by selling the machines?"

"We never sell machines. We lease a unit of machines on a royalty basis. No inventor should sell a machine outright if he can help it. He can do far better by leasing it. Then, too, we make some bias cloth and sell it direct."

"But, Mr. Gardner, you said you were retired when you took up the production of bias cloth. Why did you not stay retired?"

"I couldn't. The hardest job I know of is to play all the time. It's lots easier to work. And, as a matter of fact, I don't work very hard—I never did. I find this work I am doing here a kind of play. I get more real pleasure out of it than out of anything I know."

How Old Is the Earth?

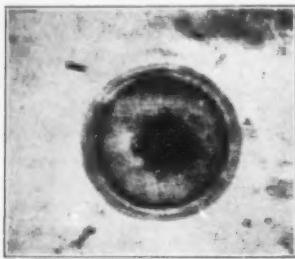
Newly Performed Research Limits the Earth's Age to 4,000,000,000 Years

By HENRY NORRIS RUSSELL, Ph.D.

*Chairman of the Department of Astronomy and Director of the Observatory, Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution of Washington*

THE various branches of science once appeared to have pretty sharply defined territories which each could call its own. But as our knowledge advances, we find more and more that the boundaries are hard to define and that certain fields of investigation now belong about equally to two sciences, and even to three or four.

One of the most notable examples of



A PLEOCHROIC HALO

This is one of the minute halos to which Dr. Russell refers. Magnified 665 diameters. Compare with drawing on the opposite page

this is found in the early history of the earth. To write the later chapters of this history is the task of geology. To attempt to find how one planet and the others of our system came into being is one of the most difficult problems of astronomy. To fill in the gap between, tasks the present resources of either, and all the aid that can be obtained from sister sciences is most welcome.

IN studying the earlier stages, for example, the astronomers determine the facts regarding the present masses, orbits and motions of the planets. They are forced to the conclusion that the distribution of rotational momentum in the system is so peculiar that the planets could not have derived the large amount which they now have at the expense of an originally rapidly rotating Sun. The only available explanation of their existence appears to be the one now familiar—that the planets were ejected from the Sun during huge eruptions caused by the close approach of a passing star, and set moving laterally in orbits by the attraction of the star as it receded.

So far the methods of astronomy—aided liberally by its inseparable companion, mathematics—enable us to follow the problem. But in the chaotic turmoil which must have followed the great outburst, detailed calculations

become impossible, and we have to accept it simply as a fact that eight large masses and vast numbers of small ones remained in motion about the sun.

These masses must at the start have been intensely hot. How long did they remain so? To answer this we must follow in imagination the condensation and cooling of a ball of incandescent vapor as it liquefies into super-heated lava and later solidifies into rock. This is a problem for the physicist who calculates the rate of loss of heat from the incandescent surface and the total store of internal heat which was there to lose.

IN this way the English geophysicist Jeffreys comes to the conclusion that the Earth when once started as an independent body would liquefy within 5000 years and become mainly solid in 10,000 more, although honeycombed with pockets of molten lava. Whenever this state was reached, the outer crust would contract to cool and soon cut off any serious escape of heat from the interior.

The atmosphere must originally have been very extensive, containing all the water of the ocean in a state of vapor; but it, too, would rapidly cool and in a few thousand years more the water would condense out and form an ocean upon the surface. Within less than 100,000 years of the original catastrophe, then, it appears that a mass which was initially gaseous but similar in size and composition to the Earth would become a planet much like our own.

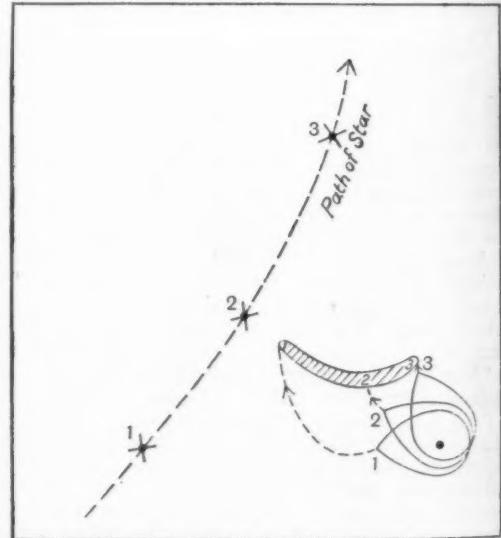
From the other end, beginning in the present and working backward, the geologists have studied the process of the wearing away of the land and the transfer of its debris to form new deposits, and have worked out a little at a time the long history of the rocks. From a study of these processes alone they can conclude that some rocks are far older than others and were crumpled into mountains and worn down to a plane long before the younger rocks were deposited on their eroded surfaces. They

find, too, that molten masses were injected into some of these rocks after they were themselves deposited, and have also been worn away so that their date, relative to the others, can be approximately determined.

THE interpretation of this geologic sequence is greatly aided by the labors of the paleontologist who from the fossil evidences of the forms of life which then existed is able to compare the ages of strata in all parts of the world and arrange them in an intelligible scheme. His work again would be impossible were it not for that of the biologist whose acquaintance with present forms of life provides the clue for the interpretation of the remains of those which have vanished.

How long, we may ask again, did these processes take? It has been plain for a century that the time covered by the geological record must be very long, running into millions of years and a great many of them.

But the first trustworthy time-scale has come since the turn of the century,



From Jeffreys' "The Earth," Cambridge University Press

THE JEFFREYS CONCEPT

The heavy black dot is the Sun; and drawing indicates the path of ejected matter during the passage of the star

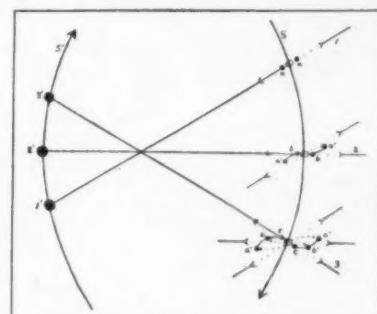
and the physicist and the chemist have supplied it. The story is again familiar and need only be sketched. In the amazing series of radio-active changes which the heavier elements undergo,

atoms of uranium one by one break up, go through a long chain of metamorphosis and a sequence of intermediate states, and finally end up as atoms of lead, after losing about one seventh of their mass in the form of ejected particles. The rate of these changes, although very slow, can be measured and it is found that 1 percent of the uranium originally present is transformed in 66,000,000 years.

NOW the lead which is formed in this way, although just like ordinary lead in all its chemical properties, has a lower atomic weight, 206.0 instead of 207.2; so that it can be distinguished by a careful analysis. Minerals containing uranium are found in many igneous rocks and have evidently crystallized out from the melt as the rock cooled. At such a time uranium and lead, which are not isomorphous (or similar in crystalline properties), would be not in the least likely to go into the same crystals. But in the minerals as they are taken from the rocks, lead is practically always present, along with the uranium; and the older the geological age of the rocks the greater is the proportion of lead. Moreover, this is not ordinary lead, but has the lower atomic weight characteristic of the radio-active product.

It is practically certain, therefore, that this lead has been produced *in situ* by the slow progress of radio-active change while the crystals were locked up in the cold and solid rock. Since we know the rate of the change, it becomes an easy matter to compute how long it is since the rock was

melted. Specimens of all geological ages from all parts of the world have thus been tested for age, with results which consistently come out small for rocks of the later geological epochs and great for the early ones. Tertiary rocks



From Chamberlin's "Origin of the Earth," University of Chicago Press

THE CHICAGO CONCEPT

Interloping star on left; Sun and ejected matter on right. The Jeffreys and Jeans concepts are modifications of this original one which ousted the old nebular hypothesis

of the Eocene Period (when the dinosaurs had already died off and the mammals were in the ascendant) indicate an age of 60,000,000 years. Those of Carboniferous age show that our coal beds are from 250 to 300 million years old. The later pre-Cambrian rocks which go back to a time when fossils are just beginning to be found (that is, when the living things which are already abundant had just begun to grow shells hard enough to be preserved as fossils) are 500 or 600 million years old; while the oldest rocks which have so far been discovered from various parts of the world run up to ages of 1200 to 1500 million years.

THE GEOLOGICAL TIME TABLE 1.0 = One million years			
ERA	PERIOD	TIME SCALE (After Barrell) Millions Maximum	CHARACTERISTIC: E.P.C.
PYCHOBIOCIC	Recent	1	1.5
	Pleistocene		AGE OF MAN
CENOZOIC	Palaeocene	2	8
	Mesocene	19	23
	Oligocene	20	30
	Eocene	45	45
	Cretaceous	95	115
	Comanchian	120	150
	Jurassic	155	195
	Triassic	190	240
	Permian	215	280
	Pennsylvanian	250	320
	Mississippian	380	370
	Devonian	380	430
	Silurian	390	460
	Ordovician	400	500
	Cambrrian	500	700
		500	AGE OF PRIMITIVE INVERTEBRATES
	PHANEROZOIC		LONG EROSIONAL INTERVAL
	Systematic classification variable	1000	Dawn of UNICELLULAR LIFE, ALGAL FORMS REPORTED
ARCHEOZOIC			

Courtesy the Field Museum, Chicago

MODERN TIME ESTIMATES

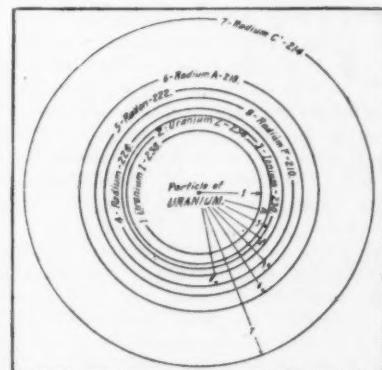
Geological table based on radio-active changes described by the author. Read from bottom, up

various "isotopes" having different atomic weights but the same chemical properties has long been suspected but was first proved by Aston only a few months ago. With the ingenious "mass-spectrograph" in which a thin beam of electrically charged atoms are subjected to electric and magnetic fields so proportioned that those of each separate atomic weight are directed to a separate point on a photographic plate, he has at last, after many vain attempts, attained many definite results with lead which show that there are three kinds of lead atoms of weights 206, 207, and 208. About 30 percent of all the atoms are of the first kind, 20 percent of the second, and 50 of the third.

ONLY the lead of the first sort can be the product of the decay of uranium. The present amount of this is a little less by weight than that of the uranium itself. A simple calculation shows that it would have been produced by the decay of the uranium of 4,800,000,000 years. If the Earth's crust had existed for longer than this, there ought to be more "206-lead" contained in the rocks, in proportion to the uranium.

We can say, therefore, as a result of our discussion, that the Earth is more than one and one half billion and less than four billion years old. The part of its career covered by the recognizable geological record has at least one third of the whole, and maybe a much larger fraction if the age of the planet is less.

These conclusions appear to be inevitable on the basis of our present



Courtesy of "Evolution" (New York)

DISTANCE DIAGRAM

From this drawing the halo on page 322 may be studied; U1 and U2 merged; Io and Ra

knowledge. It must not be forgotten that some future discovery may open up new possibilities and change our conclusion. But it should also be remembered that to reject the conclusions drawn from what we know now, merely because something might perhaps be found out some day to contradict them, would be a complete departure from the method of science.



SOME OF THE BILLIONS OF GALLONS WASTED

Four gates opened in the spillway of Gatun Lake dam, to allow overflow of the excess water during the rainy season. By raising the dam

levels or providing extra storage dams, this flood water could be impounded for later use. Increasing traffic will make it necessary

Panama Canal Needs More Water

Without Provision for Greater Water Storage, the Canal Cannot Much Longer Take Care of Increased Traffic

GATUN LAKE, the main body of water in the Panama Canal, impounds 183.2 billion cubic feet of water at its normal level of 85 feet above sea level, while there is an increased storage of 9.2 billion cubic feet if its level is raised to 87 feet above sea level. Despite this great storage capacity, water for operating the locks may be drawn only from the levels between 80 and 87 feet above sea level, representing 32 billion cubic feet. Because of this and the fact that from 50 to 60 percent of the wet season inflow is now wasted, the time is not far distant when provision will have to be made for the storage of more water to take care of increasing traffic. The Panama Canal, from the standpoint of capacity, can probably take care of all traffic passing that way for a good many years, provided there is sufficient water supply.

OF COURSE, from the Atlantic to the Gatun locks, and from the Pacific to the Miraflores Locks, the canal is at sealevel and there need be no worry about the supply for those two sections. The rest of the canal consists of the Gatun Lake and the narrows in

Gaillard Cut (formerly Culebra), really only an arm of the lake, and Miraflores Lake between the Pedro Miguel and the Miraflores locks. Miraflores Lake is small, and in addition to its

Lake, and the storage capacity of the latter lake, are the keys to the water supply.

Apparently there is no immediate need for alarm regarding the water supply but, after all, foresight was one of the things that distinguished the construction of the Panama Canal and has influenced its operation and maintenance since its completion. The fact that two consecutive, exceedingly dry seasons might leave the canal with a quantity of water insufficient for its proper operation has been foreseen for a number of years. Reference has been made to this subject in the reports of the Governors of the Panama Canal for a number of years and funds have been repeatedly requested for the purpose of making provision against a future shortage.

An Appropriation Needed

CONGRESS has been urged repeatedly to make an appropriation for the construction of Alajuela Dam for impounding more water for the Panama Canal, but the subject has so far been shelved. Traffic is increasing steadily between the Atlantic and Pacific, and the time will soon come when it cannot be handled under existing conditions.

The problem is vital and demands immediate attention by Congress, an appropriation, and the beginning of work at once.

The Editor.

natural supply of water, which is insufficient, it draws on the supply from Gatun Lake through the Pedro Miguel locks. The Chagres River, which has been dammed to make Gatun

ONCE the question of the water supply is settled, it appears that there need be no further concern about the capacity of the canal until it is necessary to build a third set of locks. Recently there was completed at Miraflores a Diesel engine operated electric power plant designed to take part of the load off the Gatun hydro-electric

plant, which is operated by water from Gatun Lake, when it is necessary to conserve the water supply to meet the needs of canal operation. This, of course, will be necessary only at the end of, or during, the dry season, as there is a surplus of water for all purposes during the wet season.

THE other plan for increasing the storage of water is the construction of a dam at Alajuela, about ten miles up the Chagres River from its junction with the canal. That the need for this increased water storage is not far distant is evident from the statement on that subject in the last annual report of Colonel M. L. Walker, Governor of the Panama Canal, which reads in part as follows: "The low level reached by Gatun Lake during the past dry season, in spite of the economies of water effected by cross filling and other expedients at the locks and partly shutting down the hydro-electric station, emphasizes the need of promptly beginning work on the Alajuela project, damming the upper Chagres to create additional storage of approximately 22,310,000,000 cubic feet of water.

"The extra storage would have facilitated operation during the past dry season (1925-1926), and, with the growth of traffic which seems probable in the next five years, the need will become imperative."

Repeated requests have been made for the funds needed for this important work and the necessary amounts for making a beginning have been included in the estimates and requests for appropriations for the Panama Canal for the past three years. Each time they have been eliminated by the Bureau of the Budget. The items are not very large, that for the preparation of plans being about 50,000 dollars, and 500,000 dollars for the first year's work on the road that will have to be built to Alajuela in order to construct the dam. Already the depopulation of



MIRAFLORES LAKE

Located between the Pedro Miguel and Miraflores Locks, this small lake contains insufficient water, but must draw on the supply from Gatun Lake through the Pedro Miguel Locks

the area which will be flooded by the new lake at Alajuela has been accomplished, and practically all of the claims for lands expropriated and the value of improvements thereon, have been settled. The survey of the route of the road has been made, but further progress with this project cannot be made until the necessary funds are provided.

THE building of the dam at Alajuela was urged by the late General George W. Goethals, former Chief Engineer and Governor of the Panama Canal, and its importance was stressed by John F. Stevens, President of the American Society of Civil Engineers, and immediate predecessor of General Goethals as Chief Engineer of the canal during the construction days. Upon a recent visit to the Panama Canal, the first since he had resigned as Chief Engineer almost 20 years ago, Mr. Stevens said: "One of the first things I did when I came back here was to look into the question of the water supply, and I found that, if more is

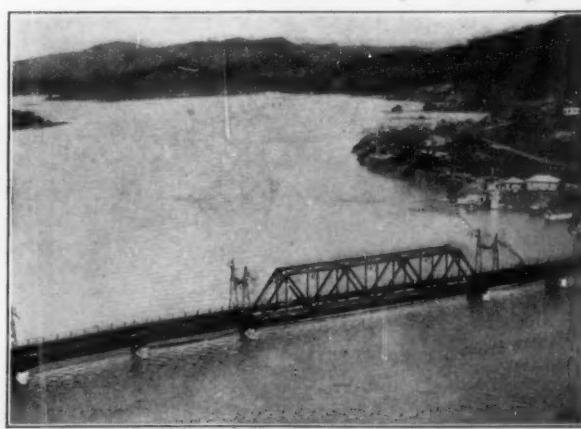
needed, it can be easily obtained by building a dam for further storage at Alajuela."

DURING an average year after the construction of the Alajuela Dam it will be possible to make 24 lockages a day throughout the dry season while at the same time operating the hydroelectric plant at Gatun at full capacity. By using the Diesel-electric plant at Miraflores to take some of the load off the hydro-electric plant, it is estimated that 48 lockages a day will be possible. Now 48 lockages indicates a capacity of more than 48 ships, as by proper routing of long and short ships, making possible tandem lockages, at least 70 ships can be handled in a day. There is no reason to doubt that the water supply will be sufficient for 48 lockages a day, or the equivalent of not less than 50,000,000 tons of shipping per annum. This is a conservative estimate, and it is probable that the water supply, if intelligently conserved, will be sufficient for a much larger volume of traffic for many years to come.



GATUN LAKE, LOOKING WEST

Of the tremendous quantity of water in this artificial lake, only a relatively small quantity can be used. Darien wireless tower at right



GAMBOA BRIDGE, CHAGRES RIVER

General view of the mouth of the Chagres River during the wet season, showing Gamboa bridge and Gamboa gravel plant, looking northeast

Herculaneum Is Being Freed

What Fire and Burning Ashes Did for Pompeii, Water Did Works of Art in Mud. They Are Now

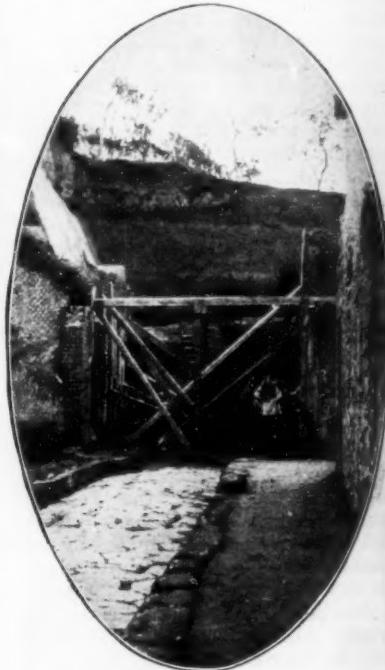


◀ HORIZONTAL EXCAVATION

An ancient city of pleasure and culture being freed from a pall of mud. The splendor of a Roman New-
port is being revealed and is giving us a wonderful cross section of Latin civilization. The work of
excavation is now being scientifically performed

▼ PROPPING UP THE WALLS

In places the mud bed is 60 feet high and special pains must be taken to prop up the architectural remains during the delicate operation of excavation. It is estimated that Herculaneum was engulfed by a million tons of mud which is being removed piecemeal



◀ IN AN ANCIENT SHOP

This view was taken in a shop of Pomponius, a colonial merchant. A huge olive oil jar was partly sunk in the pavement to facilitate the sale of that commodity. Grim tragedy stalks in the shop; for at a wine counter we find change on the marble slab pushed forward by the barkeeper, just as he met his sudden, unexpected death

▼ A MEDITERRANEAN GARDEN

The garden of the house of Argus has been planted as in the days of Cicero or Seneca. The colonnade is very beautiful. As soon as excavation takes place, the work of reconstruction is followed up. Old materials are used to do the patching wherever possible, and the new material used is in keeping



ARCHEOLOGISTS, and the great public which is so interested in history, manners and customs as revealed by the spade, have a great treat in store in the present excavation of Herculaneum, under the direction of Professor Majuri.

The tragedy of Herculaneum has no parallel in history. After having miraculously escaped the fury of Vesuvius and the torrent of ashes and stones which destroyed Pompeii in three days, Herculaneum suddenly realized that although the irate Vulcan had spared her, yet the torrential rains which followed the eruption were threatening her with dire disaster. A torrent of water and heavy mud moved slowly down the slopes of Vesuvius toward the town, amidst the cries of the horrified inhabitants, for whom there was no escape; not even the sea. What fire and burning ashes did for Pompeii,

From Her Mantle of Mud

*for the Sister City, Herculaneum, Preserving Her Priceless
Being Brought to Light by Excavations*

A PROFITEER'S COUNTRY HOME ▶

The "House of Argus" was supposed to be owned by a wealthy Roman profiteer, who liked the wonderful climate of Herculaneum. The excavation requires the removal of parts of the modern town Resina, which has existed for centuries over the buried city.

REMOVING THE MUD ▶

The workmen toil patiently and slowly with the painstaking care of the collector. Their eyes blaze with enthusiasm when the removal of a block of mud reveals a new wall, a new doorway, or a work of art. All the earth is sifted before going to the dump.



water and mud did for Herculaneum. Why Herculaneum, which contains such wonderful works of art, should have been buried for so long a time is explained by the fact that while ashes and cinders are easy to clear, mud is at least ten times more difficult and costly. The mud has now been found so thick that excavation is difficult.

Although Herculaneum has been called a sister town to Pompeii, being only three miles apart, yet they are entirely different. Pompeii was a wealthy provincial town; while Herculaneum was a rich and restful place for the wealthy. Pompeii was commercial and decadent; Herculaneum was intellectual, and Greek influences still prevailed when tragedy overtook her.

Judging from the exquisite works of art which previously have been found in Herculaneum, the world's treasures will soon be augmented.



PRIMITIVE BUT EFFECTIVE ▶

The work of excavation is done by a small army of workmen and inspectors, all of whom are lovers of art. They are satisfied to work for wages which spell starvation to the ordinary laborer. The pleasure of contributing to a work the importance of which they are fully aware, offsets pecuniary consideration. This results in careful excavation.

WHERE EXTREMES MEET ▶

The laborers bring the earth in baskets to a conveniently situated contractor's railway and dump it into tip-cars, which are then taken to the end of the line and the earth is dumped into the sea. The horizontal method of excavation is employed. The original excavations were made by shafts and horizontal tunnels, but the work was done intermittently.



The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Field

By MORRIS FISHBEIN, M. D.

Editor of the Journal of the American Medical Association and of Hygeia

Lead Poisoning From Snuff

SNUFF is usually wrapped in lead-containing wrappers. Sometimes the snuff becomes contaminated with the lead from them. On other occasions it is adulterated with lead as a coloring matter. The chromate of lead is used in this way to give a good appearance to an inferior product. Dr. Joseph Uttal has made available the reports of three cases seen in New York City of persons with the snuff habit who developed symptoms of lead poisoning due to the use of such products.

Lead poisoning is cumulative in its nature, and even small amounts regularly inhaled may give rise to the symptoms. The yellow coloring matter added to the snuff, which produced the poisoning, was proved by chemical analysis to be lead chromate. Following this investigation, the health department of New York City notified manufacturers that their products must in the future be made without artificial coloring.

In the three cases examined, the use of the snuff containing lead had caused inflammation of the nerves, with paralysis in the wrist in two, and severe general anemia in the other.

Foreign Bodies in the Stomach

TWO Canadian physicians have just made available the report of an insane woman who had developed the habit of swallowing foreign substances. In May, 1926, an X-ray examination revealed safety pins, wires, and buttons passing through her intestinal tract. However, she did not appear to be having any trouble get-

ting rid of these objects and no attempt was made at operation. One year later she developed severe pain and an X-ray picture showed the stomach completely clogged with foreign material. When this was removed, it was found to contain 2533 different pieces, including 947 bent pins, 865 pieces of bent wire, 191 pieces of glass, 176 parts of safety pins, 58 tacks, 54 parts of corset steels, 28 parts of garter fasteners and other miscellaneous objects, such as screws, beads, washers, nuts, broken keys, money, cuff links, and pen points.

Food Poisoning

THE *Journal of the American Medical Association* has just made available an analysis of 425 outbreaks of food poisoning that occurred in the United States during 1923, 1924 and 1925. In 1923, Dr. J. C. Geiger published the records of 749 food poisoning outbreaks. There was a total of 1174 outbreaks involving 7112 cases with 544 deaths from 1910 to 1925. Of the alleged causative foods, 401 were commercially preserved food material and 70 were prepared in the home, a ratio of about four to one. Of the commercially prepared meat products, beef heads led the list; of fish, salmon and sardines; of vegetables, tomatoes, corn, pork and beans, spinach, kraut and peas; of fruit, peaches, pineapples and olives. Of the home-prepared meat products, beef and sausage were first; of fish, salmon; of vegetables, string beans, corn and peas; of fruit, plums. Seven outbreaks were attributed to creamed chicken, five to creamed salad sauces, and three to other creamed sauces.

Of the 425 outbreaks studied, the

food was regarded as spoiled or off in taste or odor in 28 instances. In four instances the canned goods used were described as "swells," in which the can was bulged. In three instances the canned goods were said to have been left in the can for several hours. Canned foods when allowed to remain in an open can for several hours will not, however, cause symptoms of food poisoning, unless they are subsequently contaminated or previously poisoned.

The investigation made in the present instance is convincing to the effect that the term ptomaine poisoning ought to be discarded as descriptive of a food poisoning outbreak. In 215 outbreaks, or approximately 50 percent, the conditions involved were not actually food poisoning, but appendicitis, tuberculosis, meningitis, various infectious diseases, alcoholism, gas poisoning, metallic poisoning, and in one instance, pregnancy. When *post mortem* examinations are made on cases of so-called food poisoning, the exact causes are revealed. Therefore, it is suggested that whenever a diagnosis of food poisoning is made, that bacteriologic and toxicologic investigations be made and that some way of tracing back the origins of the cases be secured in order to make an epidemiologic study.

Sometimes unusual substances are found in canned food; in some instances tacks or nails have been reported; in six instances, a mouse; in six instances, a fly; in thirteen cases, a stone; in other cases, toothpicks, match boxes, needles, chewing gum, or grasshoppers. Sometimes the evidence is actual to the fact that in such cases the material was actually in the cans, but in many cases persons have



REMOVED

An insane woman developed a habit of swallowing foreign substances, and finally it was necessary to perform an operation on her. The pile illustrated, slightly smaller than natural size, was removed from the stomach. In the center column above, the articles recovered are enumerated



BEFORE

One side of a patient's arms, showing the elaborate tattooing that was later removed

claimed financial return and there has been at least the suggestion that the whole idea was planned with a view to securing money.

The Removal of Tattooing

TATTOOING is almost as old as man himself, since it has been found in Egyptian mummies and among the natives of the South Pacific and Japan. The most primitive method of tattooing, as pointed out by Dr. M. D. Shie, is by incising or burning the skin and rubbing various coloring matters into the wounds. Later, special apparatus was developed for the purpose, consisting of little chisels shaped like hoes which were dipped into pigment and then driven into the skin by a sharp tap with a mallet.

Most often the desire for tattooing is associated with extreme youthfulness or perhaps mental defectiveness. When the tattooed person becomes older, he can usually be observed searching about for some method of removing the coloring. This, however, is an extremely difficult process. The methods of removal include the use of surgery, in which the material is cut away or burned away; next, electrolytic methods, by which the skin is caused to fall away, after which the pigment may be removed with a needle; finally, chemical methods, which involve the use of various caustics. Cancer pastes, used for destroying superficial growths, also are sometimes applied for the removal of tattooing.

In his discussion of the subject, Doctor Shie presents a series of illustra-

tions of cases with multiple tattooing in which the material was successfully removed by the use of methods which involve the tattooing into the design of a 50 percent solution of tannic acid. After sloughing occurs, silver nitrate is rubbed into the treated area. This forms a heavy black deposit of silver tannate in the skin, and with this the tattooing material can be removed. The tattooed area gradually becomes hard and dry and slowly separates off. The entire process requires several weeks. Unfortunately it is not possible to prevent some scarring, even with the very best of technique.

Bran as a Laxative

WHEN dieticians began to realize that the American diet had become highly sophisticated and contained hardly enough fibrous material to stimulate the bowels, they sought about for food substances that might be added to the diet, in order to provide these additional necessary factors.



ALL GONE

After the treatment described in these columns, all vestiges of the tattoo marks are gone. Scars are not always avoidable

Hence it was that bran began to be used as an addition to the diet in the form of breakfast foods, muffins, and similar products. There are all sorts of bran products now upon the market, varying greatly in the amount of fiber content. It is the fiber content or indigestible material which makes the bran a roughage factor.

The cellulose can be added to the diet in the form of fruits and vegetables, as well as in the form of bran, although bran is richer in indigestible cellulose than are the other substances. Crude bran may contain as much as 18 percent of cellulose. Dr. G. A. Williams found that cellulose prepared from paper pulp had a laxative action when given in an amount equivalent to the crude fiber content of washed bran. The crude fiber of bran, however, was even more laxative than cellulose from paper pulp, since it produced an effect when its content of crude fiber was equivalent to 3 percent of bran in the food.

One of the difficulties of the situation so far as it concerns the self-treatment of indigestion or intestinal sluggishness is the fact that fibrous material is irritating. A person suffering with inflammation of the intestinal tract may



MORE OF IT

The patient's arms are shown turned partly around to indicate the extent of tattooing

do himself serious harm by the seemingly harmless process of adding too much roughage to the diet.

Insane Artists

IN Fulton Oursler's play, "Behold This Dreamer," the leading character is a young man who inclines toward the esthetic, and who wishes to be a painter. In order to cure him of his genius, his wife and her father cause him to be put away in a sanatorium. While there he learns painting from another inmate, and succeeds in producing a futuristic painting that wins a prize of 5000 dollars at an exhibition. The verification of the possibility of truth in this fiction comes from a recent exhibition, held in Paris, of drawings, paintings and sculptures made by psychopathic patients.

The drawings shown in the exhibition resembled greatly the work of the cubists, futurists, and super-realists. The eminent French psychiatrist, Dr. Auguste Marie, pointed out that it is not safe to conclude that all artists who paint material that looks like that produced by the psychopathic patients are insane. On the other hand, it can be taken for granted that the psychopathic pictures represent the production of the subconscious mind and are a revival of the primitive art of savage tribes.

One of the French psychopathic patients painted a picture of roaring flames and waves of fire so realistic that a manufacturer of wall paper bought the picture for use in a wall-paper design.



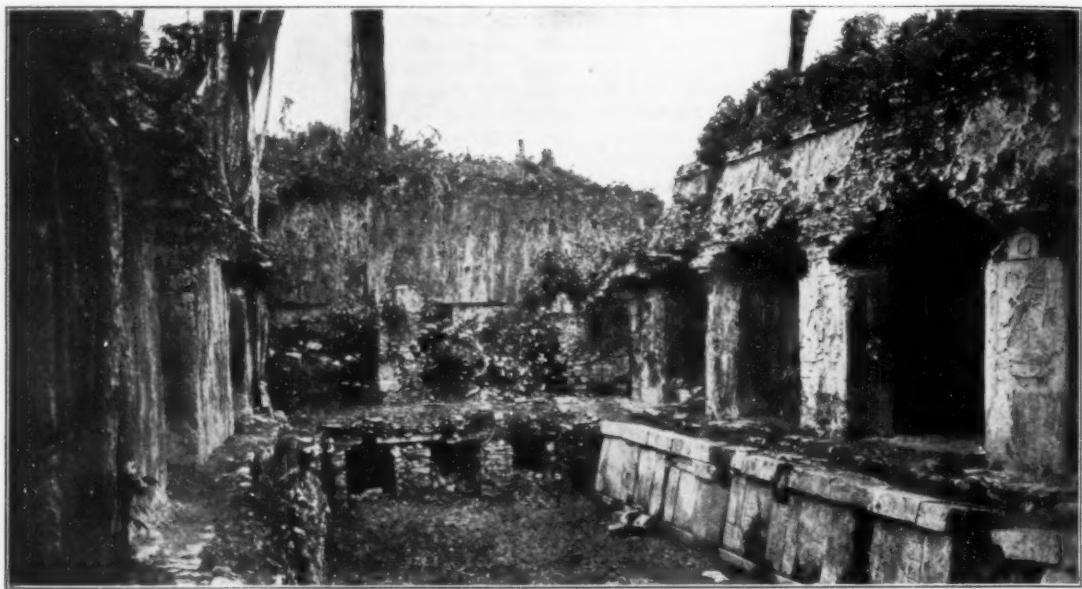
PARTLY REMOVED

The patient's arms, just after the deposit has been removed from one set of marks



DURING TREATMENT

The areas with tattoo marks on them are covered. Thirteen days after the start



MAYAN ARCHITECTURE WAS FAR ADVANCED

The masonry shown above was of stone; the rubble walls were laid up in mortar; the decoration was of stucco. The Mayas learned how to make lime mortar from limestone by calcination in fire, and their mortar shows excellent strength characteristics.

Thank the American Indian

We Owe to the Indian Well Over Half of Our Great Agricultural Wealth. Potatoes, Maize, Cacao, Beans, the Peanut, Rubber and Other Plants Were Domesticated Here Long Before Columbus Discovered America

By HERBERT J. SPINDELL, Ph.D.
Curator of Mexican Archeology and Ethnology, Peabody Museum, Harvard University

THE present economic position of the United States, the strongest of any country on earth, is due in a large measure to the plants, materials, and processes which constitute our inheritance from the ancient civilizations of American Indians. Well over half of our total agricultural wealth, in fact about four sevenths of it, consists of crops unknown in the Old World until after the momentous voyage of Columbus.

The value of this Indian inheritance annually reaches sums beyond the dreams of avarice. Farm values amount to billions of dollars and other billions of dollars are developed in the commercial turnover. But, indeed, the entire world is benefited by gifts from Indian farmers and the indications are that the economic importance of the ancient products of the New World civilization will increase rather than diminish in the future.

Man came into America from Asia on the Neolithic plane of life, bringing bows and arrows, stone axes and knives, but having no metals and no food

supply in the form of domesticated plants and animals. The tribes who remained behind in the Old World and those who immigrated to America started, as it were, from scratch in a race for the higher honors of civilization. At the time of the separation, neither group had found a stable food supply. But afterwards, each group managed to do so with the materials at hand, entirely ignorant of what was being done by other human beings with other materials, half the world around.

YET the results obtained by completely independent means are remarkably parallel. Higher achievements of social life depended directly upon ample food supply; the exact nature of this food supply was relatively unimportant so long as a balanced diet was reached. Ample food supply allowed population to multiply, and specialization in industry to take place. Kings, priests and artists were independently evolved by society in the two severed hemispheres.

In such an art as architecture, similar methods of construction and decoration were invented. The Mayas, for example, learned how to lay beautiful courses of cut stone, to make lime mortar from limestone by burning, to handle stucco decorations and fresco painting on temple walls. Their use of mortar and rubble for walls and ceilings gives a modern touch to the picture, as does their fondness for skyscraper effects. They even discovered how to burn bricks as a substitute for stone, as is seen clearly enough at the early city of Comalcalco. Similarly in weaving, the parts of the loom were independently invented in America; and in metal work, gilding, plating and casting by the lost wax processes were discovered.

Under all this Indian culture, and making it possible, were plants furnishing food, fiber and other substances which had been tamed to the garden. We are accustomed to judge the excellence of dead civilization by works of art but perhaps a fairer judgment might be based on the way the primary

problems of living were solved and the gregarious instinct given a chance to produce social organizations.

The nuclear civilization of the New World came into being on the highlands of Mexico and Central America as a result of the domestication of maize, beans and squashes. Agriculture made possible the culture which we now call "archaic" and which must have begun several thousand years before the birth of Christ. The art of this archaic civilization of the first American farmers has mostly passed away, excepting pottery objects. Most interesting of these are figurines of men and women. The archaic civilization spread north and south through arid lands and the spread of plants was accompanied by the spread of weaving and pottery making.

Then came the great burst of the Mayan supremacy, due to economic conquest of the humid tropics, beginning about 1000 B.C. The old series of plants were modified to meet wet land conditions and new plants were domesticated that were indigenous to the wet land. The Mayas themselves were the first to domesticate cacao, which Linnaeus afterwards named *Theobroma*, food of the gods. Chocolate is made from the prepared seeds of this domesticated tree. Cacao pods attached to the tree trunk in characteristic fashion are unmistakably represented in several sculptures at Copan, dating from the Fifth Century A.D. The Mayas also tamed the fruits called papaya, zapote, anona, alligator pear, and so on, and discovered the virtues of vanilla as a flavoring substance. Also to the Mexican and Central American field we must ascribe tomatoes and peppers in wide variety.

THE idea of agriculture took root in North and South America as a result of the actual spread of maize, beans, and squashes, but local plants were also brought under cultivation in several regions. For North America, outside of Mexico, the list of indigenous food plants is small: the principal items being Jerusalem artichokes and the strawberries which Captain John Smith found under cultivation in Virginia. But sugar was drawn from the sap of several species of maple by the woodland Indians, while blueberries and cranberries would doubtless have been domesticated except for their natural profusion.

In South America the indigenous food plants include the potato of the Andes, while in the rich Amazon valley a number of valuable foods including manioc, the sweet potato, the peanut, the pineapple and so on, were brought

under cultivation. Most of these seem to have been domesticated by the Arawaks in Brazil but the area of their pre-Columbian distribution included Central American and the West Indies. There are numerous minor foods in tropical America which need not be listed.

Indian farmers did their job well and succeeded in establishing many useful differentiations in their food plants. Indeed the original set of plants, namely maize, beans and squashes, were carried very far from wild types and given wider range in climatic adaptation than any comparable plants of Old World origin. Maize grows from Canada to Argentina in arid and humid lands and at high and low elevations. Squashes and pumpkins are tremendously differentiated yet there are believed to be only two basic

between New and Old World agriculture is made on cotton with three American species and two Asian species in competition. But American cotton is the cotton of modern commerce. It was introduced into Egypt about 1840 and is now rapidly displacing the native tree and herb cottons of India in India itself.

Maize was introduced into the Old World shortly after the discovery of America. It was favorably received by the Turks and from them it passed eastward across Asia, reaching China about 1540. It must be remembered that at this time the Turks were a wide-awake dominant people and that caravan trade to the Far East was largely in their hands. Maize is often called Turkey grain in Europe and it is of some interest that two American birds, the turkey and the muscovy duck are given European names from the European regions of first acceptance. Also the Turks took to tobacco from the first and now have varieties in their own name. Another case of adoption is the potato which is now called Irish simply because it lifted an Irish famine.

IN Chinese archives the references to the introduction of maize are explicit. Instructions were given that the yield be turned in as taxes in order that the government could distribute seed. Today maize is an important food in Italy and the Balkans. It thrives in South Africa and in parts of Australia. It is the most valuable single crop in the United States.

The Portuguese were the most important distributors of domesticated plants and were especially active in carrying plants from Brazil to Africa, India and China. For instance, they carried cabuya to Mozambique and in modern commerce it is frequently called Mozambique hemp. The Spaniards came next with their colonies in Mexico, Peru and the Philippines exchanging products. The sweet potato is still grown in the Philippines under its Aztec name camote. The French, with Louisiana and other establishments in South America and the West Indies, were not far behind. They introduced into the Island of Bourbon or Reunion, in the Indian Ocean—mostly famous for the romance of Paul and Virginia—cacao, vanilla and a species of long fiber American cotton. This Bourbon cotton was transplanted into southern India at the end of the 18th century.

Not only materials but processes and uses were discovered by the American Indians. In the case of maize, the method of boiling the grain with lime was widely known, giving rise to



THE MONKEY GOD OF CACAO

In the lower left-hand side of the picture the god may be found, with the cacao pods attached to his limbs and tail

species. Also there are two basic species of the legumes we now call beans, namely the *Phaseolus vulgaris* and the *Phaseolus lunatus*, but out of these come more varieties than can be mustered by the peas and lentils of the Old World. The Mandan Indians of North Dakota, on the margin of agriculture, had corn that would mature in 60 days and they also had rapidly maturing squashes and several distinct varieties of beans.

Other economic plants of the American Indian are tobacco, cotton, henbane, cabuye and several other fiber plants. The only direct comparison

our present lye-hominy. In the case of manioc, the poisonous hydrocyanic acid was pressed out from the grated root in basket tubes and the special processes of making cassava and tapioca were perfected in ancient times.

The world owes rubber and several important uses of it to the Mayas and adjacent tribes in the wet lands of Central America including the Olmeca, or Rubber People. The oldest specimens of rubber are doll-like effigies recovered from the Sacred Cenote at Chichen Itza, and in the same city is a great ball court in which a game was played with a large rubber ball. This ball had to be thrown through rings of stone set high in walls on either side of the court, something after the fashion of basket ball, only the rings were set vertically instead of horizontally. This game had its religious side but seems to have been a fine spectacle.

RUBBER was much used for incense, as a binding material over cord wrappings, for tipping drum sticks, and so on. It was also used to water-proof cloth and strips of beaten bark reduced to the thickness of stout paper. A Guatemalan document dated 1540 speaks of "rubber whose profitable uses the Spaniards took from this province where the people were much given to varnishing boots, capes and other useful objects to make them water-proof, and to make tennis balls."

Any one who has traveled in the more humid portions of Central America is familiar with the waterproofed ponchos and duffle bags which the Paya, Mosquito and Sumo Indians still make. Of course, commerce has branched out from *Castilloa elastica* to the rubber drawn from the *Hevea brasiliensis*, but would this have been possible if



THE GOD OF MAIZE

His head is an opening ear of maize. A sixth century sculpture from Copan

the cult of rubber had not extended into South America among the Indians? A writer on guayule, the shrub rubber of northern Mexico, once said to me, "Of course, I know that guayule is a recent discovery but I have often wondered what the name meant." He was somewhat surprised when I explained that the word was a compound of the Aztec word *hue* or *guay* meaning old and *ulli* meaning rubber—literally "old-fashioned rubber."

HARD on the discovery of America came a great use of Indian medicines in Europe and even though some of these are now regarded as having little real therapeutic value, others are of prime importance. In the opinion of the times the most important medicines coming from America were guayacum wood or *lignum vitae*, and sarsaparilla, used to combat the disease which Columbus' sailors had introduced into Spain in 1593 and which immediately swept over Europe in a dreadful epidemic.

Another sovereign remedy was Mexican jade, named *petrus nephriticus* and held to cure kidney diseases by sympathetic magic. Kings passed pieces of jade in their wills, so precious was it. Tobacco and copal were also introduced as medicines, but the first soon became the vice of philosophers and the second served as a basis of varnish. Numerous American Indian medicines held their own as remedies, however, examples being cascara sagrada and quinine, the latter perhaps the most valuable medicine in the world for its assistance in reclaiming the fever-ridden tropics.



THE GODDESS OF WATER

She holds ears of maize in her hands, water being the prime need of the maize plant

Many dyes were discovered and developed by the American Indians, none having a more interesting history than cochineal. This brilliant and beautiful red, now given up by the textile trade in the interest of cheap standardization, comes from southern Mexico. The minute insect whose body gives the red stain was domesticated and grown on the nopal or prickly pear cactus. These plants were set out in plantations with little mat tubes filled with Spanish moss attached to the leaves as nests in which the insects were hatched. We find records of cochineal paid as tribute to the Aztecs and under the Spaniards the cultivation of cochineal became an important business. The prickly pear cactus was introduced into Spain, northern Africa and so on, in an attempt to raise cochineal nearer the European market.

ANOTHER Indian dye, the result of domestication, was añañ, or American indigo. It is a matter of some interest that the Indians of Central America also learned how to use the secretion of the murex shell fish for a purple dye.

In the Old World, the emphasis was on domesticated animals, but this source is so uneconomical that the use of flesh will doubtless decrease in the future. On the other hand, American Indian plants such as maize, potatoes and sweet potatoes head the list as giving the greatest yields of human



GOD OF MAIZE, PERU

A bundle of actual ears supplied the mold for this tusked god whose children also show

food for a given acreage in temperate lands, maize being nearly twice as serviceable as wheat in this regard. There is good reason to believe, then, that the foods of the American Indian will be increasingly important to all humanity and that the arts and other social achievements of the New World will gain prestige as time rolls on.

A Mountain That Will Fall

*Evacuation of the Territory Which Will Be
Affected Has Already Begun*



All illustrations courtesy of *The Illustrated London News*

PREDESTINED TO BE DAMMED

The steep sided Arbedo Gorge which will almost certainly be stopped up with the 150,000,000 tons of the sliding mountain above, as explained in the frontispiece, page 296. On the right is Monte Arbino. Following the catastrophe, the stream will fill the space behind the dam, forming a large reservoir. Then the loose dam will burst!



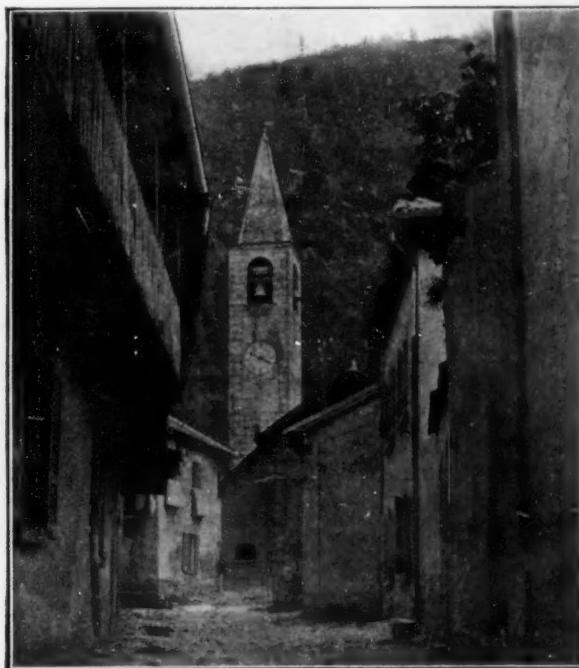
IN THE SHADOW OF DESTRUCTION

The walls of the Castello Montebello, and in the remote distance the tottering top of Monte Arbino. The latter is 5560 feet high and is near the Swiss-Italian border at the celebrated Lake Maggiore. In 1881 a great fall of earth and rock destroyed the village of Elm. More recently a tremendous rock fall in Asia caused an earthquake



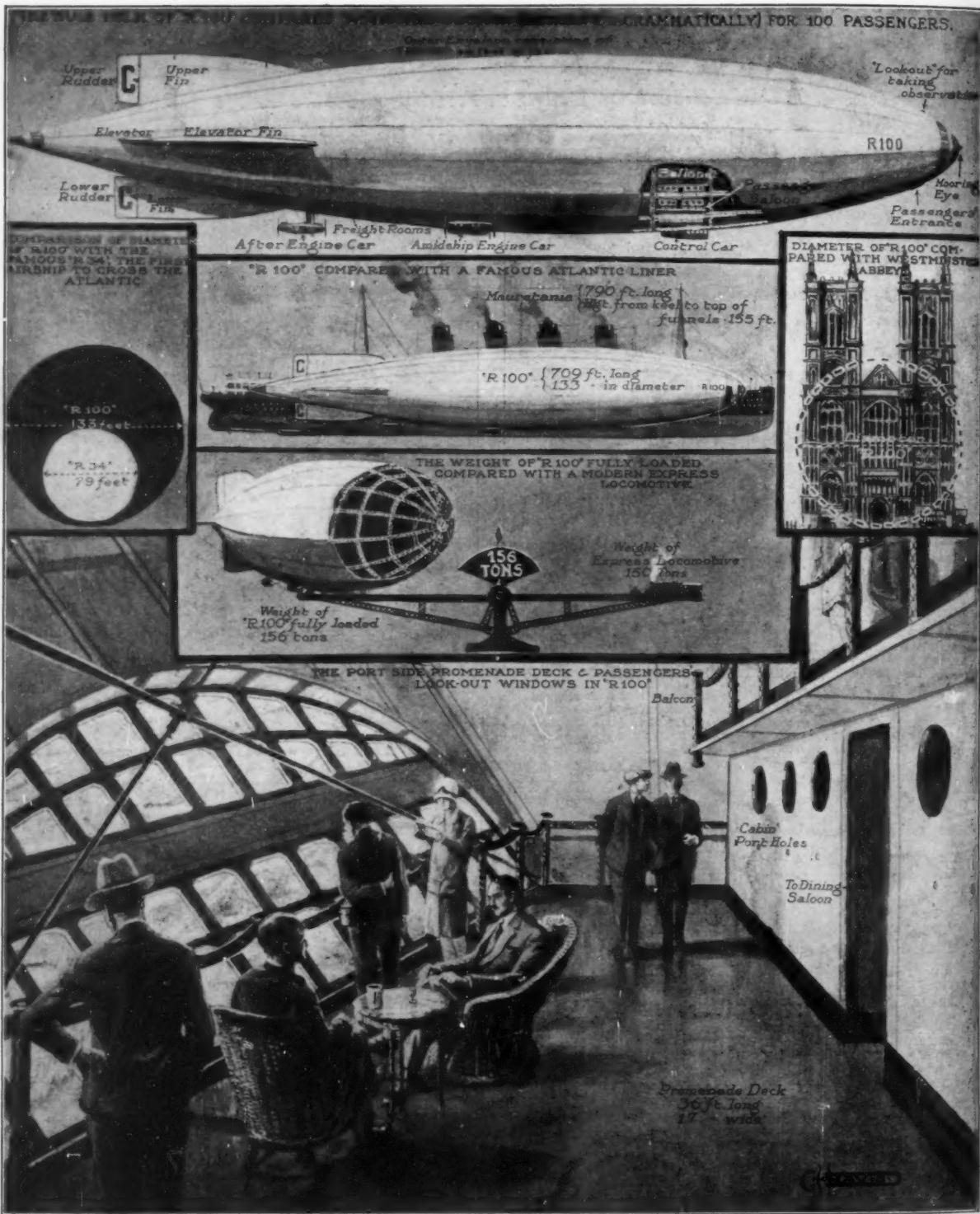
MENACED BY THE IMPENDING FLOOD

The little mountain community of Bellinzona on a market day. Here we see people engaged in their normal occupations. At some time in the future, destruction must overtake this peaceful scene, for the waters impounded behind the dam, once it bursts, will be irresistible



ALL THIS MAY BE BURIED

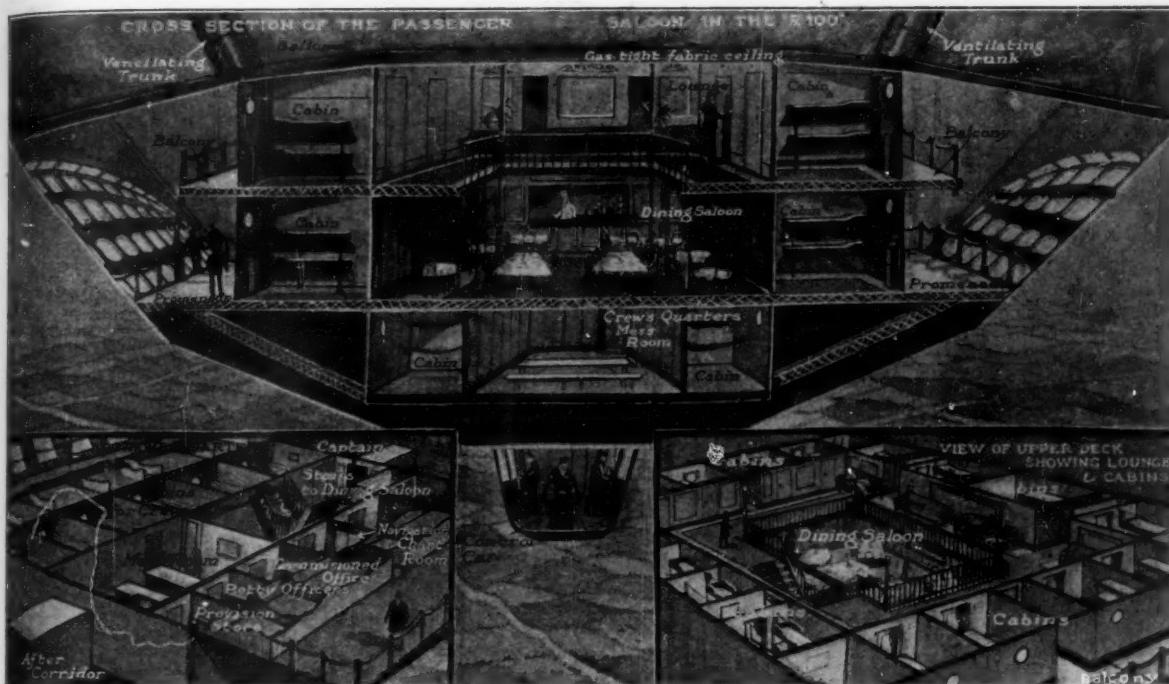
Arbedo, one of the several places threatened by Monte Arbino, a part of which shows in the background, is doomed, for it will doubtless be buried under the overwhelming mass of earth and rock which some slight accident such as the turning of a hair may launch upon it



Facts About New Giant Air-Liner

WITHIN the year of 1928, it is reported that the gigantic airship *R-100* will take the air in England. The ship is now under construction by the Airship Guarantee Company, Ltd., at the Howden Aerodrome, Yorkshire, England. In the above illustration are given some of the more important and interesting details of the rigid airship. As shown in the top-most drawing, the quarters

for the 100 passengers that the ship will carry are located in the forward part. Further to the rear are the engine nacelles and the compartment for carrying freight. Connecting all of these is a gangway, which extends toward the nose of the ship to the point marked "Passenger Entrance," just to the rear of the mooring eye, in the upper drawing. See opposite page for further details.

Illustrations courtesy of *The Illustrated London News*

SECTIONAL VIEWS OF THE "R-100"

The upper drawing is a cross-section through the passengers' and crews' quarters, and shows, to the right and left, the observation promenade. Lower drawings give more complete details of the two decks and serve to show the complete comfort that is provided for everyone on board

"R-100", Latest British Airliner

Dirigible Has Accommodations for One Hundred Passengers and Will Carry a Crew of Forty

ON this and the opposite page are given the details of the airship *R-100* now under construction in England. The ship will be 709 feet long by 133 feet wide at its greatest width. The area of the fabric that will be required to cover the rigid frame is 225,000 square feet for the outer envelope. The framework is to be of novel construction, composed of tubes of duralumin. More than 10 miles of this tubing will be required for the structure.

THE power plant of the ship will be in three sections, two of them in gondolas slung side by side about midships, and the third on the center line further aft. In these cars will be six Rolls-Royce "Condor" type engines, each of 650 horsepower. Also there will be smaller motors for driving the dynamos that furnish lighting current.

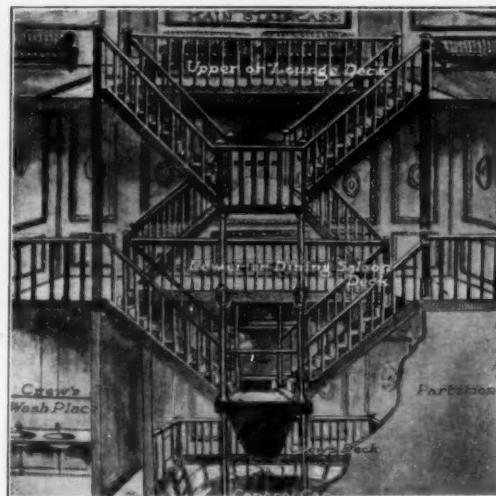
The passenger accommodations are to be placed within the huge hull, well forward, as shown on

the opposite page. The plans call for three decks in all, two for the passengers and the third or lower one for the crew. The latter consists of the

captain, three commissioned officers, a coxswain, elevator coxswains, riggers, fuel guard, chef, and stewards—40 in all. In the passengers' decks are provision for 100 persons. The large dining room in the center deck will accommodate 50 diners at a time.

On each side of the passenger compartment, level with the center deck, will be a promenade with specially constructed windows which will afford a perfect view of the countryside or water over which the airship is traveling. Note the angle at which these windows are built.

EVERY precaution will be taken to prevent the gas in the balloonets, composed of gold-beaters skin, from escaping to the passenger compartment, and elaborate fire prevention methods will be employed. The entire passenger saloon will be built of fireproof fabric with a framework of fireproofed Balsa wood—the lightest yet strong material obtainable for the purpose.



THE MAIN STAIRCASE

Like a view within a palatial ocean liner is this illustration of the stairs within the passenger compartment of the R-100



Courtesy California Highway Commission

A DANGEROUS GRADE CROSSING ELIMINATED

Safety on the highway frequently means the separation of vehicular from railroad traffic. In many localities, this is accomplished by highway underpasses, while in others, as here, a bridge carries the highway over the dangerous railroad tracks.

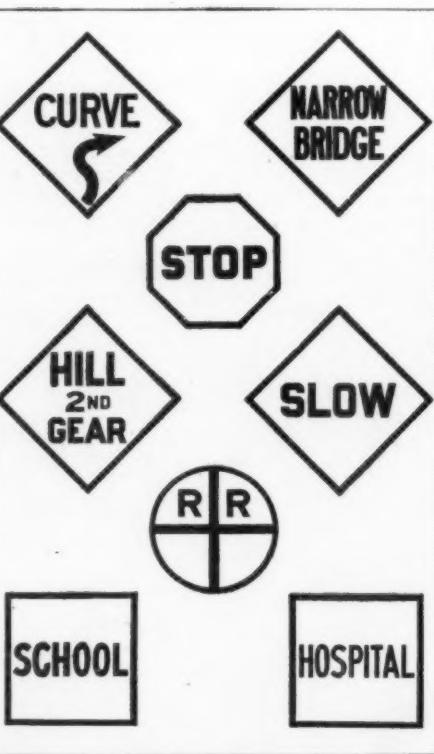
Safety on Our Highways

The Elimination of Grades and Curves is a Great Factor in Decreasing Accidents on Our National Highways

THE present is pre-eminently the age of individual transportation. There are to be found on our highways today more than twenty million motor vehicles, sufficient in number to supply one to each family in the United States. It is predicted that in seven years we will have one vehicle to every four persons, sufficient to furnish one to each individual that is old enough to reach the steering wheel.

Although we are improving our highways at a rate never dreamed of before, we cannot keep pace with the demands created by the enormous increase in vehicles. Last year alone, more than four and one third million motor vehicles were produced, an increase over the preceding year of 20 percent.

DURING this period, about 40,000 miles of highways were surfaced, an increase of but 11 percent. It is then evident that we are producing motor vehicles twice as fast as we are providing improved roads for them. This condition has brought about a traffic congestion on our streets and roads so acute that we now realize that one of our major problems is to provide sufficient street capacity to permit safe operation of all vehicles.

**STANDARDIZED SIGNS**

By using certain sizes and shapes of signs to indicate kind of danger, warnings are made sure

The enormous increase in traffic on our limited mileage of improved roads, coupled with the ever-increasing speed of travel, the weight of motor vehicles, has meant not only a great economic loss, but has resulted in a steady increase in highway accidents, taking a toll in human life and property damage so great as to arouse public opinion to a demand for more extensive highway improvements to keep abreast of motor vehicle registration. The demand is for roads so built and maintained as to permit quick and safe transportation at all times. Likewise, highway engineers now realize that safety is as important as engineering and economics in the design and operation of our highways.

IN the interest of safety, highway engineers are relocating the main roads to eliminate curves, to avoid railroad grade crossings, and to reduce steep grades. Incidentally, these relocations save distance, avoid costly bridges and mean large benefits to the motorist in the cost of vehicle operation. For instance, in Illinois, a road 150 miles long was relocated almost entirely throughout its length, thereby saving 30 miles of unnecessary distance and eliminating 31 grade crossings. The saving in vehicle operation to the citizens of that state, as a result of this improvement, is estimated at one million dollars a year.

The frequency of highway accidents resulting from traffic congestion has demonstrated not only that we must construct our new highways of ample width, but also that we need to widen many of the roads and bridges now in use. This has led to the construction near large industrial centers and on main thoroughfares of what is known as the "super-highway" to insure the maximum road capacity, speed and safety. It is only by widening our congested roads and by providing alternative routes, that accidents can be reduced and traffic enabled to move smoothly, quickly, and with a maximum degree of safety.

FOREMOST of the super-highways is the one out of Detroit which has a total width of 204 feet, with two separated roadways 44 feet wide, each carrying one-way traffic. On each of the four-track roadways, horse-drawn traffic keeps to the right-hand curb; slow moving, heavy trucks outside them, and automobiles in the two other lanes, thereby providing rapid, safe, and easy movement for all kinds of traffic. In addition, space is provided between the roadways for trolley lines, and provision is made for motor parking, as well as for pedestrians.

Other highways on which extensive widening programs are going on, or parallel routes are being extended, are the Pacific Highway in the state of Washington; highways out of Chicago; the Lincoln Highway west of Philadelphia; the Boston Post Road between New York and New Haven; as well as

and New York is now under construction.

To relieve traffic congestion and to promote safety at the intersection of important roads, highway grade separations are being planned. The first

attention of large communities to the desirability of routing through traffic around the edge of the town rather than into the business district. In Philadelphia, a belt line has been provided for routing through traffic



HARD WORK WAS REQUIRED HERE

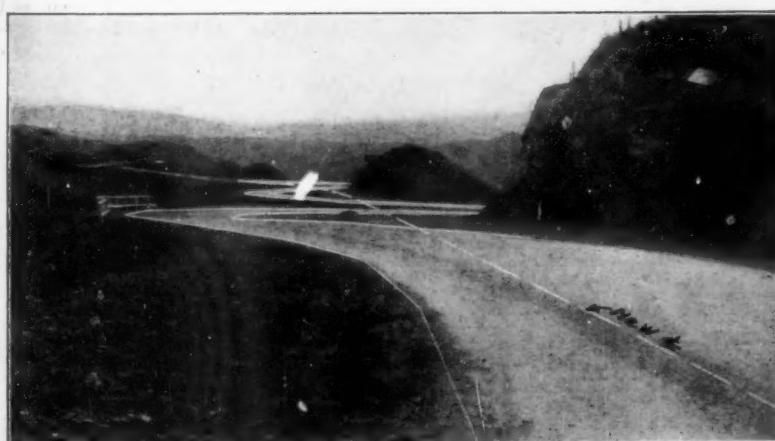
To reduce the gradient of the road and eliminate or reduce curves, this highway in California was cut through solid rock. The roadway is of ample width—40 feet at this point.

structure of this kind is now being erected just north of Chicago at a very congested highway intersection. The design provides for two levels. Through traffic proceeds on an overhead bridge on one of the roads, while turning traffic swings wide of the bridge and uses the ground level.

Traffic congestion may usually be charged to the slow-moving vehicle. As the speed of the vehicle naturally

around the edge of the city; while in Delaware, the DuPont highway, which extends the entire length of the state, avoids built-up sections.

One of the most recent developments in the interest of public safety is lighting the rural highway at night. The greatest menace of night driving is the abundance of glaring lights which makes driving at such times dangerous. Lighting the highway not only reduces this danger, but also increases the capacity of the road by making it available for maximum use throughout the 24 hours of the day, and serves as an inducement for trucks to operate at night when passenger traffic is at a minimum.



HOW IT WILL BE STRAIGHTENED OUT

In this photograph the present winding form of a roadway is shown. The dash line indicates the route that it will follow after the highway has been completely reconstructed.

roads leading out of Cleveland, Akron, and Cincinnati.

One of the developments of the future may be separate roads for freight and for passenger service, a low grade, heavily constructed road for trucks and a less expensive type for passenger vehicles. A road planned primarily for trucking between Boston

affects road capacity, it is possible that one of the developments of the future may be a penalty for not maintaining a minimum, as well as for exceeding a maximum speed.

When, in addition to local traffic, all through traffic is also made to pass down "Main Street," congestion must result. This condition has forced the

AN important step to promote highway safety was recently taken by the United States Bureau of Public Roads in co-operation with the state highway departments, in adopting uniform standards for warning signs to be used throughout the country. The motorist will no longer be confused by a multiplicity of signs of various designs and degrees of legibility. Hazards will be indicated by signs which will be uniform in all states and which will plainly indicate the kind and degree of danger. The new signs make use of a system of different shapes, thereby increasing their value at night. The shape indicates the degree of hazard and if the motorist cannot read the legend, the shape will tell him the degree of caution required. See illustration on opposite page. Twenty states are now actually engaged in erecting these standard warning signs, and other states have signified their intention of doing the same.

Simplified Photo-Radio Transmission

*Only Ninety Seconds Required For Complete Sending
and Receiving of Photographs*



COMPARED with the development of radio telephony in the past eight years, that of photo-radio transmission has been comparatively slow. However, a process developed by Dr. E. F. W. Alexanderson, and recently announced and demonstrated by the National Broadcasting Company, has been perfected to a surprising degree. Especially is this true in the simplicity of the apparatus employed. In fact, the receiver is so simple that it can be used in the average home by one with but little training in picture transmission.



AS SENT AND RECEIVED

The photograph at the left (of D. McFarlan Moore, inventor of the neon tube used in the receiver), is a reproduction of that placed on the transmitter cylinder. The one at the right shows received photograph



B



C

As shown in photograph A, the receiver consists of the usual amplifiers and tuning arrangement, a neon tube encased in a box and connected to the amplifier output, and the recording drum mounted on a spiral thread. The drum revolves and at the same time moves along the spiral thread. The fluctuating rays from the tube fall on a sensitized paper placed around the cylinder, "scanning" the moving surface. This paper is later developed to bring out the image.

The transmitter is shown in photograph B. A revolving disk, with a serrated edge, breaks up the light rays, which then fall on the photograph to be transmitted and are reflected to a photo-electric cell. A receiver for the home is shown in the photograph at C.

Co-ordinated Ear and Eye Music

Reproducing Piano Rolls Contain Explanatory Notes Which are Thrown On Screen While Music is Played

THE introduction of the photograph under its many names, and especially the great growth of radio, has created a peculiar condition in the piano business which has materially advanced mechanical and inventive features. The perforated music roll in its improved form has taken the player piano out of its former position and has endowed it with qualities of artistry which were formerly unheard of. Now comes another improvement which enables us to see the music while our ears enjoy it.

This new system, which is called "Audiographic Music," depends upon a clever utilization of the opaque projector. With the instrument attached to the piano, a group of people may receive instruction by the eye. The perforated roll used is a regular reproducing-piano roll except that it has biographies, pictures, notes on the music, explanatory remarks, et cetera, printed right on the roll.

The projector illuminates the roll, whether still or moving, with the aid of two 500-watt incandescent lamps. An electric fan serves to keep the projection box cool. A tube holds the lenses and allows focusing. A mirror serves to transfer the image to a transparent screen. A switch enables the lecturer to start and stop the roll at will, thus al-

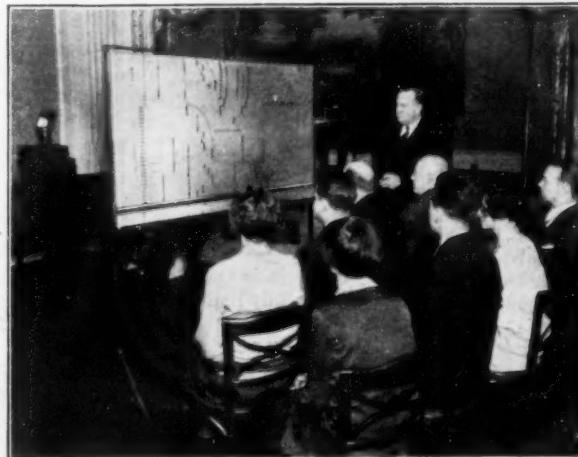
lowing ample time for reading the biographies or extended musical notes.

Three hundred world-famous musicians have taken part in making these explanatory music rolls. The rolls are presented in far distant countries in the English, French, Spanish, and German languages. Leading musicians such as Walter Damrosch, Conductor of the New York Symphony Orchestra; Sir Alexander Mackenzie of England; Charles Marie Widor of France; E. F. Arbos, Conductor of Ma-



ADJUSTING REFLECTOR

The projector, which is of the opaque projection type, fits over the roll and tracker bar. Two 500-watt incandescent lamps are used for illuminating the roll



WATCHING THE NOTES

A transparent screen is used to receive the image from the moving roll. When long descriptive notes are to be read, the roll is stopped to permit this

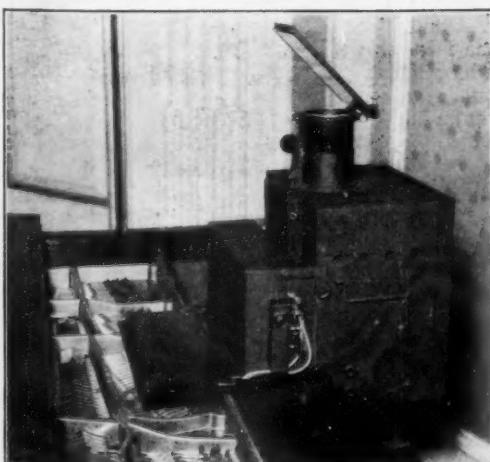
drik Symphony of Spain, and Franz Schrecker, Director of National Conservatory, Berlin, have taken part in this making. Percy A. Scholes, music critic of London, and Charles H. Farnsworth of Columbia University, respectively, are European and American editors in charge.

The roll pictured here is typical. It is "Fingal's Cave Overture" of Mendelssohn. Several sections preceding the actual music have been read, telling of the composition, how it happened to be written, giving

a picture of the Fingal's Cave on the Isle of Staffa, Scotland, and then simultaneously with the actual hearing of the music, is presented the running comment telling the story being given by the music—as it develops, and also going through the theme, and phrasing marks, the position of the melody, the repetitions, modulations (key changes) and the pianist's phrasing as they (in this case, Rudolph Ganz and Ernest Hutchinson) play the selection.

This new method of music presentation offers portentous possibilities for the future of a music-loving world. It promises to promote a better understanding of the art, to illuminate the hidden beauty and meaning of that which has hitherto been vague and shadowy. The projector, flashing a reproduction of the roll on the screen, opens up a new path of knowledge as the mind absorbs the notes printed thereon. Siegfried Wagner, himself, gives to the world in this system an authentic and intimate version of the origin and meaning of his renowned father's works. Sir Edward Elgar writes his own confession of the mysterious Elgar Variations about which much conjecture has been made. Such information coming simultaneously—yet silently—with the hearing of the music, compels attention and makes a lasting impression.

A small model for the home will soon be placed on the market.



All photographs courtesy The Aeolian Company

THE PROJECTOR IN ACTION

The projector is in normal position and the musical notes or explanations are thrown on the screen with the aid of lenses and mirrors. Note angle of mirror shown

Facts About Hypnotism

Many of the Results of Hypnotism Are in Dispute. The Author Puts Forth Some Interesting Arguments

By G. H. ESTABROOKS, Ph. D.
Associate Professor of Psychology, Colgate University

HYPNOTISM is a peculiar state of the mind in which the subject appears to be asleep. But it is a very curious sleep because he will, within limits, do anything which the hypnotist tells him. He is asleep yet he acts at times as if awake.

This is not as contradictory as it sounds. A person may talk in his sleep but not remember what he says. Better still, a person may walk in his sleep with the same result. Here you see certain parts of the mind—let us group them under the name "subconscious mind"—handling the body very effectively without any assistance from the conscious mind. We may even go a step further and get in touch with this sub-conscious mind. You may ask the sleep talker a question and often he will answer you. From this you may engage him in conversation and request him to go for a walk with you or you may give him other simple orders. You are now in touch with the subconscious mind and he is to all intents and purposes hypnotized.

When the doctor hypnotizes a person, he simply, by means of a special technique, puts the person into this condition wherein he is asleep and yet can do many things which are impossible to the ordinary sleeper. He does not know consciously what is happen-

ing but the hypnotist is in touch with the subconscious mind and through it can control the body and make the subject carry out his orders. The subject is in exactly the same condition as if he were walking in his sleep but obeying the voice of another. Some

It Is Done

EVEN today there are many who say, "Hypnotism is the bunk, for I have seen so-called demonstrations of it on the stage, and I know that they were fakes." Hypnotism on the stage, and the serious efforts of the scientist are far different things and must not be confused. The results that are obtained by the serious-minded investigator are often even more marvelous than the illusions of the average stage performer. In the September, 1927, issue of this Journal, Dr. Walter Franklin Prince, noted psychic investigator, referred to Mr. Estabrooks' work.

The Editor.

told to do so? I will devote the main part of this article to a consideration of these two points, since my views are here somewhat different from those of most psychologists.

Now, as to whether a person can be hypnotized against his will. The answer is "Yes," at least in some cases. We have to consider several points. One of these is the fact that only about one fifth of adult people can be deeply hypnotized under *any* conditions. So obviously we cannot say that all people can be hypnotized against their wills. There are, however, several conditions under which those who *can* be hypnotized might be acted upon against their wills.

First, after a person has once been deeply hypnotized, the hypnotist can often give certain suggestions, as a result of which the subject can be hypnotized at any future date without his consent or even against his will. Consequently, we may say that once a person has been really hypnotized by a clever operator, he may then be put to sleep by this operator at any time, regardless of his will. Therefore, we have to limit our question still further by asking whether a person who is susceptible to hypnotism can be hy-

sleep walkers can be made thus to obey orders and are then really in a hypnotic trance.

The two outstanding points of interest in hypnotism are suggestibility and rapport. By suggestibility we mean that the subject is very open to suggestions; he will literally believe or do anything you tell him, within certain limits. If you assure him there is a bear in the room he will see it and show every evidence of extreme fear. If you tell him that he is a dog he will get down on all fours and bark. If you give him a rubber dagger and tell him to stab someone, he will oblige.

BY rapport we mean that the subject is in touch only with the hypnotist. No one else can influence him. A dozen other people may shout orders at him and he will remain perfectly unaffected, only to carry out the slightest request from the hypnotist. He acts as if he were deaf to all other voices than that of the operator.

Popular interest is centered around two points. First comes the question as to whether a person can be hypnotized against his will and secondly, is the problem of the hypnotist's control. In other words, just what can the subject be made to do? Will he steal, or commit murder or attempt assault if



HYPNOSIS BY FIXATION

The subject merely gazes at a bright object. The state of hypnosis can be induced easily in certain people by means of this method



SELF HYPNOSIS

Here the subject is attempting to eliminate the personality of the operator by inducing hypnosis by concentrating on an object, and listening to music through earphones

noticed the first time against his will.

Undoubtedly so, under some conditions! There are a few people who habitually walk and talk in their sleep. Some of these will answer questions and obey orders if skilfully handled. From here they can easily be thrown

into a state of genuine hypnotism. There are also a few people who by their very nature are extremely susceptible to hypnotism. Certain types of hysterics fall in this class. Without the least doubt, these people, if caught off their guard, could easily be hypnotized, at least without their consent.

But these cases are exceptional. Can the ordinary individual who is susceptible to hypnotism be influenced against his wishes? Undoubtedly he can, in some cases. Anyone can resist hypnotism provided *he knows he can do so*. There is the hitch. The moment a person gets in a panic or becomes afraid that the operator may succeed, just at that moment he is beaten. It is a waste of time for any hypnotist to attempt to influence a normal person who is perfectly confident he can resist, but let that person doubt his ability to resist, or become afraid of the operator and it is a wholly different matter.

FOR example, we all know the stern discipline in the German army before the War. A certain German psychologist wished to try an experiment, so he announced to a number of soldiers that he was going to hypnotize them. Their officer, who was in league with the hypnotist, told him to go ahead but absolutely forbade the men to allow him to hypnotize them. The hypnotist had rather startling success. The men knew nothing of hypnotism. The very name struck fear in their hearts. Moreover, the command of their officer merely made matters worse. They realized it would be a serious offense if they allowed the hypnotist to succeed. Consequently they were in mortal terror lest he should succeed and yet regarded him as some uncanny sort of person wielding a power against which they could do nothing. They literally hypnotized themselves by their own

fear! Bernheim, greatest of all authorities on this subject, summed up the whole matter by saying that it was impossible to hypnotize any normal individual *provided he knew he could resist*.

But there is a final possibility of hypnotizing even the normal individual. Hypnotism, we know, de-

suggest to him that at three o'clock tomorrow afternoon he will go to Mr. B's office and shoot him with a gun which I hand him. Then let us suppose that I turn to my assistant and explain to him, so Mr. A can hear me, that the whole thing is an experiment and that the gun is loaded with dummy bullets. Actually I hand Mr. A a

HYPNOSIS BY THE SLEEP METHOD

This system was perfected by the French psychologist, Bernheim. The subject relaxes and by co-operation with the operator, endeavors to fall asleep while the operator still maintains touch with the sub-conscious mind of the subject



pends on disassociation of the nervous system. We know that strong emotions tend to produce this state and also that certain drugs probably do the same. Now suppose the hypnotist is given free play to treat the subject as he sees fit. I venture to think that by means of violent emotions such as fear, by loss of sleep and perhaps also by the use of certain drugs, he could so shatter the subject's nervous system that hypnotism would be a possibility even against that person's will. This, however, is purely a theoretical point and one which certainly cannot be demonstrated in everyday life.

Let us now consider the power which the hypnotist can exert over his subject. In general, this is summed up in ordinary psychological opinion by saying that the individual will do nothing in the hypnotic state which is fundamentally opposed to his moral nature and which he would not do when fully awake. For instance, we can get a subject to commit murder with a rubber dagger or to "shoot" a person with a gun that isn't loaded or forge a check which will be torn up ten minutes later. In other words, the subject knows he is playing a part. His unconscious mind seizes up the situation and realizes that it is all a farce in which he is to assist—and he does so. Give him a real dagger or a loaded gun and results would be different. He would bluntly refuse to do as requested and probably wake up.

TO all of which I agree, but beg to point out that it really does not answer the question. In fact, I believe the hypnotist's power to be unlimited—or rather to be limited only by his intelligence and his scruples. For example, let us consider a hypothetical case. Suppose I hypnotize Mr. A and

gun loaded with live ammunition, and Mr. A thinks it is the usual farce in which he is to take his part. I wonder how many of my readers would be willing to act as Mr. B? Personally I am convinced that Mr. A would commit the murder.

Of course, you at once raise the objection that Mr. A has really done nothing against his moral nature. I have only fooled him—made him my dupe. But I point out that it would not have been possible without the aid of hypnotism. Moreover, I can arrange it so that Mr. A will have no memory of whence that suggestion came, no memory of being hypnotized and will even deny knowing me at all. So I have Mr. B murdered and the only one who is responsible under our laws is Mr. A. Practically I have attained my end, whatever the ethical implications may be.

BUT the hypnotist can go even farther than this, provided he be a really unscrupulous person. For example, he can take Mr. A and suggest to him in the hypnotic state that Mr. B insulted him yesterday. This memory will be just as real to Mr. A as if it really occurred. And from here he can gradually work on Mr. A's feelings, slowly building up in him a positive hatred of Mr. B. To be sure, this will take time but I firmly believe that in six months or a year a skilful operator could accomplish his ends even to the extent of having murder committed.

All of which indicates that hypnotism is a very bad toy to play with. It is a highly dangerous weapon in the hands of the unscrupulous and everyone who permits himself to be hypnotized by any other than a fully competent and reliable psychologist or medical man is inviting trouble.



HYPNOTIC DANGER

The whirling teeth of the saw are sufficient to induce a condition of hypnosis in a certain type of person. This is one of the main reasons for protecting workmen



READY FOR THE ELEMENTS

Clothed in cold-resisting garments, and equipped with apparatus for supplying life-sustaining oxygen, the aviator is ready for a high-altitude flight

COUNTLESS men have felt the call of the Arctic and have battled its snow and cold. The fight with the elements and the lure of the open spaces stir the imagination of anyone who has red blood in his veins. But you do not have to go north for the Arctic, as the Arctic is everywhere, complete with its blizzards, bitter cold and raging winds.

Above the steaming jungle is the same challenge that lies within the Arctic Circle. Within gunshot of your home in the center of civilization are spaces that defy the courage, stamina and resourcefulness of man to their utmost. The adventurous spirit need not travel to the poles to satiate his desire for a hand-to-hand conflict with nature. Instead, let him stay at home and travel upwards for a few miles. Here are winds of hurricane violence, cold more piercing than that of the Arctic, and air so rare that his lungs are denied their precious oxygen.

THE pioneers of the air are perhaps greater heroes than their comrades of the far north. A properly trained man may live in the Arctic and endure the rigors of the climate for months at a time, but the man who attempts to reach the record altitude encounters conditions which forbid long exposure and all but rob him of his life in a few hours' time. He is numbed by the cold and his faculties are deadened

Where Perpetual Winter Reigns

Only a Few Miles From Each of Us Exist Sub-Zero Temperatures and Winds of Tremendous Velocity

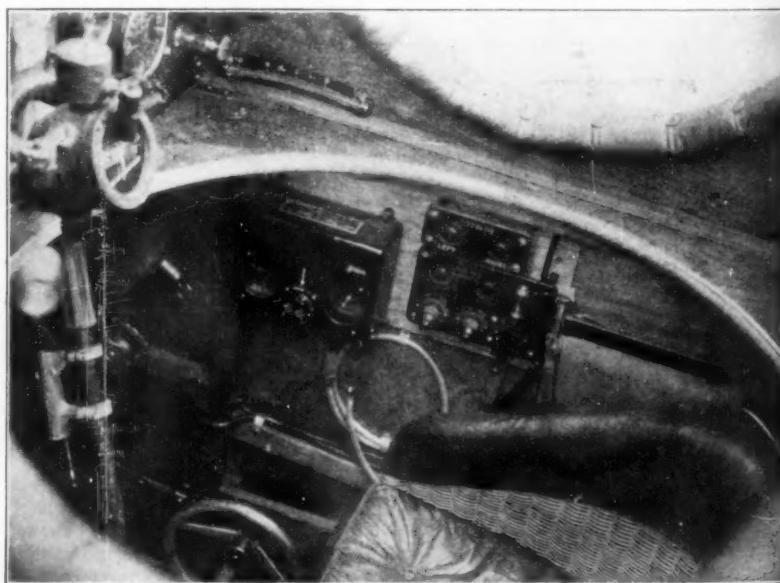
By E. F. BACON and JOHN W. WAGNER

by the lack of oxygen. Danger, in fact, follows him down to the ground, where, exhausted, he must skilfully land his plane or suffer the consequences.

The Arctic explorer has equipment which long years of experience has shown to be sure protection against the elements, while the altitude flier depends on apparatus which is now only in the first stages of its development, and for that reason is not absolutely reliable. Improvement in all phases of engineering is largely the result of failures, and altitude equipment is no exception. Non-descript clothing used on the early flights resulted in suffering, which in turn was responsible for the remarkably comfortable flying suits which are now available. Failures of superchargers and engines have speeded their perfection. There is one part of the altitude equipment which must not fail, and that is the oxygen apparatus, as a failure here means sudden unconsciousness or even death.

The United States Air Service has recognized the importance of the work and has done intensive experimentation during the last few years. Due to this work, the means of providing an adequate and absolutely reliable oxygen supply has been brought to a high state of perfection. Two types of equipment are available, one of which uses oxygen under high pressure, and the other using liquid oxygen.

THE gaseous oxygen is carried in steel tanks about five inches in diameter and 20 inches long, and is under about 2000 pounds per square inch pressure. The tank is connected by means of a copper tube to a regulator which automatically controls the amount of oxygen that is needed by the pilot. A rubber tube with a mouthpiece is connected to the regulator and through it the pilot breathes the gas. The regulator consists of two parts, one of which reduces the pressure to



WITHIN THE COCKPIT

Just to the left of the light control on the side of the fuselage is located the automatic gaseous-oxygen regulator. This instrument controls the flow to the pilot proportionally to the altitude

about 50 pounds while the other meters the gas in proportion to the atmospheric pressure. Care must be taken to see that the oxygen is free from water, as at the extremely low temperatures encountered, any moisture in the gas would freeze on the valves and



Official Photograph, U. S. Air Service

TANK AND REGULATOR

The tank of gaseous oxygen contains sufficient of the gas to last one man for a flight of one hour. To the right of the tank is the device for regulating the supply

prevent proper functioning, and even cause total failure.

As gaseous oxygen is easier to procure and transport, it is the general standard for service use. Liquid oxygen possesses several advantages over it but is difficult to handle. Vacuum-walled containers, similar to the common thermos bottle, are used for containing liquid oxygen. It boils continuously at a temperature of -220 degrees, Fahrenheit, and in the best containers available at the present time, 50 pounds will evaporate com-

pletely in a week. One volume of liquid boils to 970 volumes of gas at atmospheric pressure, so that a very small volume of liquid provides ample gas.

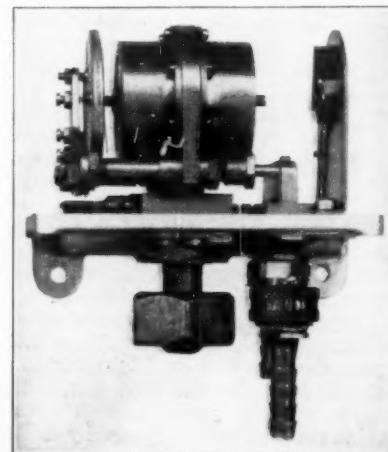
On the airplane, the liquid is carried in a vacuum-walled container. A copper tube is sealed into the container and passes down into the liquid. The part of the tube extending out of the container is wound into a coil, and a rubber tube connects the end of it to the pilot's mouthpiece. As the liquid boils slowly in the container, the pressure above it increases and forces the liquid up into the copper coil, where it boils rapidly and furnishes the gas. The container is equipped with a safety valve and a pressure-regulating valve which controls the amount of liquid forced into the coil, and therefore the amount of gas. Because of its lightness and reliability,

**OXYGEN BOTTLE**

This is the special type of container employed for transporting liquid oxygen. To prevent rapid evaporation of the precious liquefied gas, the bottle is constructed with double walls; the space between is evacuated

known fact, proved many times, that a man may be increasingly inefficient and approach even the state of unconsciousness without his being aware of any change in his ability.

As greater and greater altitudes are being attained every year, the question arises as to whether or not there is an altitude limit above which man cannot live. The flight surgeons of the Air Service say there is, and indicate that it is rapidly being approached. Their experiments have proved that a certain amount of pressure in the depths of the lungs is necessary to sustain life. This pressure has been found to be about one pound per square inch. Now



Official Photograph, U. S. Air Service

REGULATOR

Here are shown the "works" of the latest type of automatic regulator which supplies the gas as demanded by the effects of high altitudes on the pilot's respiration system

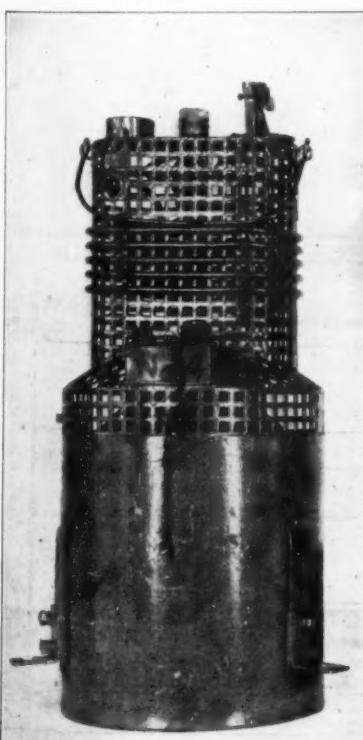
a liquid oxygen vaporizer is used in record attempts.

Individuals vary greatly in their ability to withstand the effects of high altitudes. With few exceptions the limit of consciousness for man without oxygen is about 25,000 feet. The mountain climber, becoming acclimated, due to his slow ascent, is enabled to go slightly higher, but even he can remain at this height but a short time. As far as aviation is concerned, this altitude represents the endurance limit, and men flying above 18,000 feet, should, as a general rule, be provided with oxygen.

The efficiency of a man is greatly diminished even at this altitude, although consciousness may be retained. The effects of insufficient oxygen come on in an insidious way, and it is a well-

**ALTIMETER**

The instrument maker is still several jumps ahead of the altitude record. This altimeter will indicate the height up to 50,000 feet



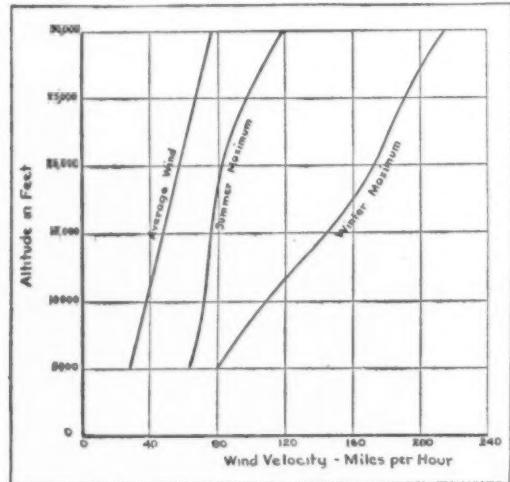
Official Photograph, U. S. Air Service

LIQUID VAPORIZER

Liquid oxygen must be expanded to a gas before it is employed for breathing. This tank holds enough for four men for four hours

the pressure of the atmosphere at sea level is about 14.7 pounds per square inch and it decreases with altitude until at a little above 40,000 feet, the pressure is only about two and one half pounds.

Suppose that the pilot is breathing



WIND VELOCITY ALOFT

At 10,000 feet, the winds almost invariably blow from the west. Flying at 30,000 feet, it is said that under favorable conditions, a flier could cross the continent of the United States in about eight hours, due to the "tail" wind

pure oxygen from an oxygen apparatus at this height. From the atmospheric pressure of available oxygen must be subtracted the partial pressure of water vapor present in the lungs, which is about one pound per square inch. This leaves about one and one half pounds; but, in inspiration, the pressure is reduced about one third from the point where it enters to the depths of the lungs, leaving about one pound, theoretically. This assumes pure oxygen which at present cannot be the case, due to air dilution through the mask. Another danger is the shortage of carbon dioxide in the body, due to excessive breathing. This gas enables the blood to give up its oxygen to the tissues, and if sufficient is not available, the effect is the same as a deficiency of oxygen. For these reasons it is calculated that somewhere between 40,000 and 50,000 feet is the absolute limit for man.

THE obstacle of diminished oxygen will not, however, halt the progress of altitude flying, because at least two means of circumventing the difficulty are apparent. These are to build an air-tight cabin for the pilot, or to provide a suit somewhat similar to that worn by deep-sea divers. Both plans, however, present engineering problems of difficulty. The first case would necessitate a structure of great strength with sealed control openings; windows which would not frost; an oxygen supply to overcome the effect of leaks and keep the pressure up to at least ten

pounds per square inch; a pressure-relief valve that would be absolutely reliable; and some means of absorbing the carbon dioxide which would be exhaled.

A pressure of ten pounds per square inch does not at first seem excessive, but when it is realized that it is over 1400 pounds per square foot, the true magnitude of the problem is evident. Constructing a suit might be a trifle easier in some respects, but the problem of finding a material of the required strength, which is also elastic enough to allow the pilot to manipulate the controls, is no easy one. Frosting windows, valve difficulties, and cumbersome bulk must all be given careful attention.

High-altitude flying will, without doubt, bear the same relation to aeronautics that racing has held in regards to the automobile industry. In the latter case, high-speed engines of refinement and reliability have been evolved, the passenger car of today incorporating the features

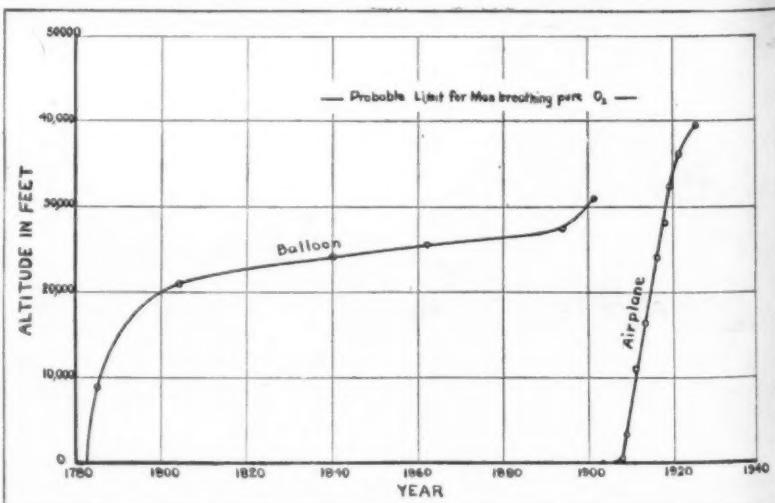
of the racing car of yesterday. In aviation, the features of high-altitude airplanes will crop out in future airplane design, creating airplanes which will climb faster and have a higher ceiling than those of the present. At first these features will be more applicable to military than commercial needs, as in the military plane the superiority of the upper man is a well established truth. Fair days, during the next war, will see photographic planes take off miles behind the lines and climb rapidly until

they pass silently and invisibly over the front at altitudes of 40,000 feet or more. Without fear of anti-aircraft guns, photographs covering a hundred square miles at an exposure will be taken at leisure. Light bombers, constructed with special characteristics, will bomb unsuspecting towns and fortifications, and return, unseen, from their mission.

OF course, there will be commercial applications, chiefly in regards to photography and high-speed express service. The winds of the upper air have been extensively studied, and certain general conclusions have been reached. These are that the higher the altitude, the stronger are the winds, and that they almost invariably blow from the western quarter. In summer, at 30,000 feet, these winds reach velocities of 120 miles per hour. It is not unreasonable to expect that Lindbergh's time in crossing the Atlantic will be cut to 14 or 15 hours. Specially built machines will rise on the Atlantic coast, climb to 35,000 feet, and wing their way eastward at speeds of 250 to 400 miles per hour. This epoch in transportation will amply repay the strenuous efforts of the pioneers of the upper air, and the whole world will benefit by their sacrifices.

For high-altitude flight, superchargers will be utilized which will maintain the engine power in the rare atmosphere. And if the engine power is maintained at altitude, it will be possible to fly faster in the thin air, than near the ground in dense air.

Q A new application of aircraft to peace-time use will be described in a near future issue. Airplanes are now being employed for "spotting" purposes by those who hunt seals.

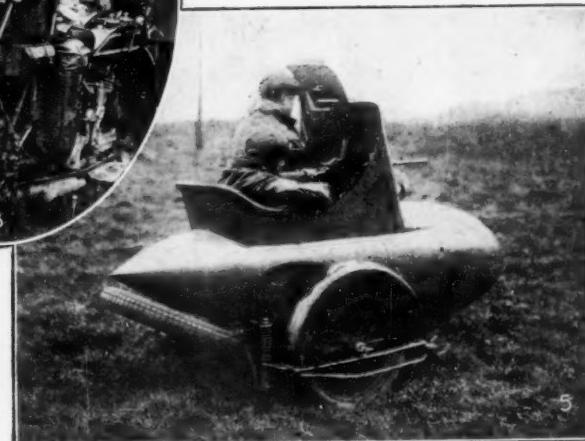


THE ASCENT OF MAN

The steep curve for airplane altitude records, as compared with the curve of record climbs for balloons, indicates that gaining a thousand feet in a plane is becoming more and more difficult. The limiting altitude above which man can live, unless he is encased in a tank or pressure-resisting suit of some type, as suggested in this article, is rapidly being approached

Motorcycles Go To War

In France They Are Developing This Vehicle Into An Efficient Battle Steed



All photographs F. and A.

AT the French Army camp at Satory, an extensive demonstration was recently staged in which the motorcycle and sidecar played the chief role. The photographs on this page show some of the interesting applications of war equipment to this vehicle. In Number 1 the sidecar has been supplanted by a tank for transporting airship gas. Low-flying enemy aircraft can be followed easily and attacked almost anywhere by the machine-gun-equipped motorcycle shown in Number 2. General Maurin, Artillery Director, Number 3, is transmitting a message by a telephone which functions by means of a battery attached to his sidecar. The wires have been laid on the ground from the reel on the rear, while the motorcycle



speeded along. The motorcycle in Number 4 has been equipped as a sending and receiving wireless station. The antenna is strung from a standard erected on the car to another (not shown) mounted some distance away in the soil. The value of this mobile unit in warfare can be realized when it is

understood that in the World War the problem of quick establishment of communication was often so serious as to retard greatly the movement of troops and supplies to the front. The armed and armored motorcycle and sidecar in Number 5 furnishes another unit of protection that will be of value since it may speed to distressed points on short notice. Photograph Number 6 shows a special rubber raft being inflated to transport motorcycles

across rivers or other bodies of water. The folded raft and the foot pumps shown here may all be carried in the sidecars. Other adaptations of motorcycles and sidecars to the uses of war were numerous but the ones shown here may be taken as indicative of the French Army's newer developments.

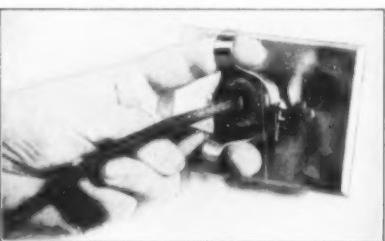
Inventions New and Interesting

A Department of Illustrations of the Newest Aids to Greater Efficiency, Comfort and Convenience



STORED HEAT BAG

Contains chemicals which store up many hours' heat when bag is boiled in water a few minutes—*Thermophor Mfg. Co., 625 6th Ave., New York, N. Y.*



ELECTRIC PLUG GRIP

Designed to save the cord, this new device may be fastened to any attachment plug by a set-screw.—*Ren Mfg. Co., 80 Main St., Winchester, Mass.*

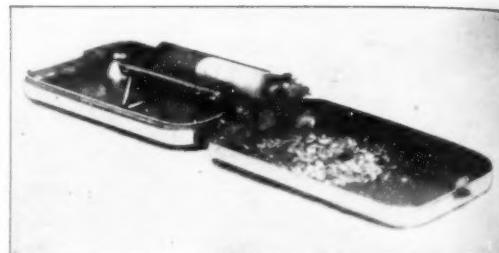


"FOUNTAIN-PEN" MICROSCOPE

A practical scientific instrument with magnification of 25.—*A. Gallenkamp & Co., Ltd., 19-21 Sun St., Finsbury Sq., London E.C. 2, England*

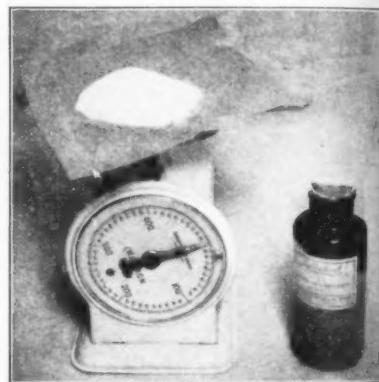
POCKET ASH TRAY

Although when closed, this attractive novelty appears to be simply a cigarette case, it is, in reality, a combination cigarette rest, cigarette extinguisher, and ash receiver. It can be carried in a man's vest pocket, a lady's handbag, or the automobile door pocket.—*Safeway Mfg. Company, Inc., Suffolk, Virginia*



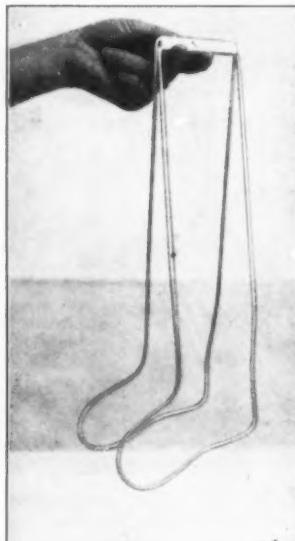
Better Service

WITH this issue we inaugurate the policy of giving under each photograph on this and similar pages, the name of the manufacturer or seller of the article pictured. This is an added service to our many interested readers who have, heretofore, been faced with the necessity of waiting for an answer from us, to their inquiry regarding the name. This departure from our former policy does not mean that these pages will in any way be changed in character, nor that the strict requirements which we demand will in any way be lessened, for the editor chooses each device solely on its merits and with regard to the possible interest of our readers.—*The Editor.*



DIETARY SCALE

To follow a diet prescription, place plate on scale, rotate dial to zero, add proper weight in grams of first food item, rotate dial to zero, add the second item, and so on.—*John Chattilon & Sons, 85 Cliff St., New York City*



STOCKING DRIER FRAME

For holding separately, a pair of baby's stockings; hinged at top to hang over clothes line.—*J. B. Timberlake and Sons, Inc., Jackson, Michigan*



SPECTACLE LIGHT

This tiny powerful light snaps on any spectacle frame instantly. It is useful for doctors, dentists, and others who make close examinations.—*Comprex Oscillator Co., 775 E. 143rd St., N. Y.*

New Gardening Tools

The Man or Woman Who Has a Garden Plot Will Welcome the Announcement of These New Aids



LAWN SHAVER

Has 36 interchangeable blades like a safety razor and cuts closer than an ordinary lawn mower. Blades can be replaced at a cost of 10 cents each.—C. A. Gratiot, Portland, Oregon



POWERFUL PRUNER

Limbs the size of a broom handle can be easily sheared with this British tool, due to strong leverage.—Lewis & Conger, 6th Ave. at 45th St., N. Y.



TINY SPRINKLER

The slotted orifice sends forth a fine spray when this device is connected to the hose. It can be spiked to the lawn and left to do its work.—Pasadena Sprinkler Co., Pasadena, Cal.



HOSE HOLDER

The hose nozzle is clamped under the hand grip, the device is then set in the lawn by means of the pointed rod support, and the angle of spray adjusted.—Practical Appliances, 45 Westbourne Terrace, Brookline, Mass.



ROOT WATERER

Consists of a hollow tube, pointed and with holes in lower end, surmounted by a handle with hose connection and cut-off valve. Inserted in ground at root of plants, it wets the root bed. Also used in fertilizing.—Stauffer Machine Works, Honey Brook, Penna.



WEED PULLER

Like the claw of a hammer, the forked point of this device "straddles" the weed stem, and the hump acts as a fulcrum to give strong leverage. It obviates digging the lawn.—Lewis & Conger, 6th Ave. at 45th St., N. Y.

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Diesel Ship Tests Show Good Results

SOME time ago the Shipping Board converted eight ships of its fleet to Diesel drive, and the report now comes from the Department of Maintenance and Repair that these have given satisfactory service, already having covered about 275,000 miles. Three more have just been converted and are on their maiden trips, a fourth is in the shipyard being converted, and eight more are to be converted at once according to a recent decision.

Many protests have been made against this conversion, some directed against the expense of the change, and others against the doubtful success of the venture. So far, it is claimed, the results have been very good, but experts will make a careful study of the operation of this class of drive as applied to the Shipping Board vessels compared to other types of marine propulsion under consideration, and their findings will probably determine the future program.

The ships that have already been converted and are in service now, are getting a good chance to show what they can do in winter weather. It is reported that some have been hampered to some extent by the rough weather they have encountered. Vibration in rough seas is one of the biggest problems the engineers have to face when considering Diesel drive for ships and it remains to be seen whether or not satisfactory means of overcoming or nullifying it may be worked out.

Concrete Bridge Destroyed in Tests

DELIBERATE destruction of a modern concrete bridge is the strange adventure in research recently undertaken by engineers representing the leading technical

This exceptional opportunity came about when the Swift Island bridge spanning the Yadkin River, between Albemarle and Mt. Gilead, North Carolina, was about to be rendered useless by submersion in the waters of a new dam. It had been erected in 1922 and was of reinforced concrete.

Abandonment of the bridge, and its replacement by a new span at a point above the new high-water level enabled engineers to pursue investigations of a type never before undertaken with reference to reinforced concrete arch stresses.

The bridge consisted of three open-

Board, the American Society for Testing Materials, and the United States Bureau of Standards.

Temperature studies were given an important place in the program. These were conducted by means of thermometers placed in holes drilled into the concrete of the arch and filled with cup grease. Preliminary studies were made for checking temperatures against results obtained in subsequent tests of the concrete by the imposition of heavy loads.

A vital factor of the study was the imposition of tremendous loads on the roadway, for the purpose of learning how a modern concrete bridge behaves under the strain of heavy traffic. This was effected by means of two heavy wooden tanks, built for the purpose. With inside dimensions of 12 by 20 by 18 feet, each tank weighed 47,000 pounds when empty. Filled with water they weighed 160 tons apiece.

For the purposes of the loading tests a tank was placed in a number of positions on the bridge. The loads were varied by using the tank when empty, and when loaded partly and fully. The 160-ton burden of a single tank, applied in the early first phase of the test, wrought no damage other than the development of surface cracks underneath the arch. For the second phase, after the continuity of the superstructure had been destroyed, the loads involved the use of a single tank with varying weight of contents. The purpose of these latter tests was to approximate as nearly as possible the conditions generally assumed in designing arches.

As a climax to the undertaking, the engineers introduced a third and final phase of the investigation, represented by an effort to cripple the main arch of the bridge

Note for Telescope Enthusiasts

Owing to an unfortunate circumstance, the new department on amateur telescope making, promised on page 244 of the March issue, was not included in the present issue. Readers may, however, look for it in the next, or May, issue.—The Editor.

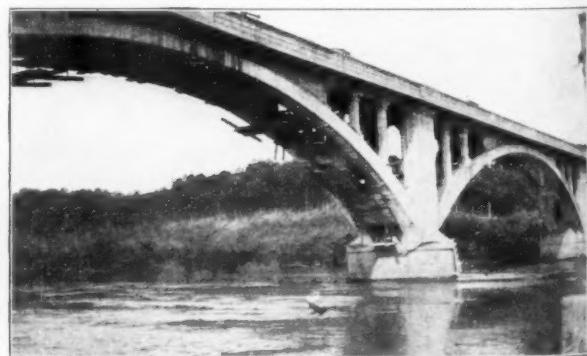
spandrel arch spans, each of them approximately 150 feet in length, and 14 T-beam or deck-girder spans of approximately 40 feet each. The entire length is 1069 feet, or more than a fifth of a mile, from face to face of the end bents.

To give full value to the load tests, the engineering program was carefully organized in advance of the actual work.

Co-operating with the two agencies responsible for the original construction—the North Carolina State Highway Commission and the United States Bureau of



The bridge in North Carolina which was weakened in a series of engineering tests for strength and finally destroyed by the War Department. Note loading tank



False work was constructed under the arches to afford a platform footing for the engineers in their careful observation of the stresses and cracks caused by loading

agencies of the United States. In this experience the technicians have had the unprecedented privilege of testing a comparatively new structure and measuring the punishment it would stand, with a view to solving stress and strain problems that influence bridge design and construction.

Public Roads—there was present an advisory committee of distinguished engineers representing important research organizations, such as the American Society of Civil Engineers, the American Railway Engineering Association, the American Concrete Institute, the Highway Research

under the application of severe loading. For this phase both tanks were used, with full capacity of water, giving a combined burden of 320 tons.

The studies conducted by the engineers included various measurements dealing with the behavior of the arches and piers

We waited two years to tell America about this *grainless* wood!

Possesses remarkable workability and uniform strength. Very dense and tough. Highly resistive to moisture. Has a very smooth, attractive surface on the face side, and requires no paint for protection. Also takes any finish beautifully. Send for large, free sample.



One of the most fascinating chapters in recent industrial history is the story of Masonite Presdwood, the *grainless* wood board from Laurel, Mississippi.

We have waited two whole years to tell this story; waited until our product had conclusively proved in actual use that it was as good as we knew it to be.

This it has done, and today Masonite Presdwood is efficiently serving mankind in scores of ways.

As a lining for safety-deposit vaults, Presdwood plays a vital part in the automatic alarm system of the modern bank.

The builder of a soaring terminal tower, desiring an exceptionally fine, smooth surface, uses Presdwood—for concrete forms.

A Kansas City baker, wanting to keep his bread and rolls perfectly fresh, packs them in Presdwood boxes.

A Nebraska farmer sits down in the evening to enjoy his new radio, and the tension board in back of the loud speaker is Presdwood.

Down on the lower Mississippi, a steamboat paneled inside and outside with more Presdwood.

Out in Hollywood, Masonite Presdwood again—thousands of feet of it used in making movies.

New uses discovered almost every day

Masonite Presdwood uses range from doll houses to bridges and flumes. Advertising signs along the highways, campers' tables, a safety wheel for swimming pools, barbecue stands, theater props, starch trays for candy manufacturers—all these, and many other things of Masonite Presdwood.

In planing mills and woodworking plants, as in so many other lines of industry, the demand for Presdwood is increasing by leaps and bounds. Breakfast

nooks are made of it; so are kitchen cabinets, china closets and shelving. Not forgetting counters, show cases, display booths, work-bench tops!

Masonite Presdwood is actually a better product than Nature's own material; better in four ways. It is *grainless*, has greater moisture resistance, is much denser, and is far tougher! Yet it contains no foreign substance, not even a chemical binder. It is genuine wood—and nothing else—wood torn apart and put together again.

Fresh, clean chips are shot from guns at a velocity of about 4,000 feet per second. The long fibres thus produced are packed into hydraulic flat bed presses, and subjected to hundreds of tons of pressure. This super-tough and sturdy material, entirely free from knots and other defects, is then cut by automatic machines into boards four feet wide and twelve feet long.

Advantages of Masonite Presdwood

Masonite Presdwood won't crack, check, split or splinter. It is highly resistive to wear and moisture, and shows minimum contraction and expansion.

It can be used on any woodworking machinery: planer, sander, shaper; and because it contains no grit or foreign substance it does not damage tools.

Comes in convenient size—four feet wide by twelve feet long. Requires no paint for protection. Yet takes any finish: lacquer, paint, stain or varnish.

Why not experiment with Masonite Presdwood yourself? Large free sample will be forwarded promptly on request. Send for it today.

MASON FIBRE COMPANY

Sales Offices: Dept. 1648, 111 W. Washington Street
Chicago, Illinois

Mills: Laurel, Mississippi

* IN MAKING MOVIES

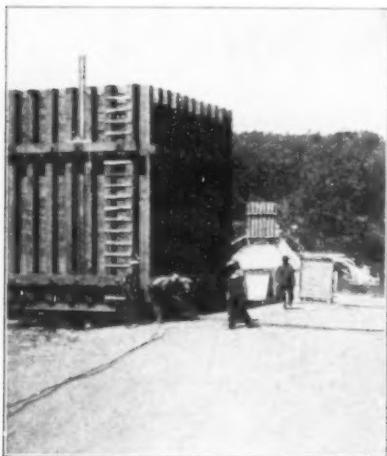


Masonite
PRESWOOD
Made by the makers of
MASONITE STRUCTURAL INSULATION

IN BUILDING BOATS



under heavy loads. Some of the factors to which special attention was devoted were the changes which occur in the length of the main arch when the loads are imposed, the change in form of the concrete and steel at 24 points on the arch rib, and the displacement of the axis of the bridge as a whole. Deflection of the crown of the arch was measured by means of a taut piano wire, fixed at one end, passing over a



Close-up of a loading tank. The other is on bridge in distance

pulley, and carrying a weight at the opposite end. The weight maintained uniform tension along the wire's length. This device enabled the engineers to measure the movement of points in the columns, by measurements between the points and the wire.

After all tests had been completed, United States Army airplanes and artillery conducted elaborate tests to determine the efficiency of their respective implements of warfare, the result being total destruction of the bridge. See page 215 of the March issue of SCIENTIFIC AMERICAN.

An interesting comparison afforded by the tests will involve checking the actual measurements against those obtained from a model of the bridge under ordinary engineering practice.

Detailed study of the test results will require 12 months.

Ancient Hittites Used Eight Languages

CHILDREN of the Hittite race who went to school in Asia Minor about 1000 B.C. had to learn dead languages just as the modern school-boy learns Latin. Baked clay tablets found in the capital city of the ancient Hittite empire have been deciphered by scholars who say that eight languages are represented on them, written in the neat, wedge-shaped characters known as cuneiform writing.

The Sumerian language was then long dead, but the Hittites learned it and taught it to their children because they believed that charms sung in the old language were peculiarly effective. In some of the tablets, the Sumerian text is followed by columns containing the same text translated into official Hittite language and into Babylonian, and also a column pronouncing the Sumerian words. Babylonian was apparently the language of diplomacy among the Hittites.

Several thousand tablets were discovered

in a palace and a temple used as a record office by German archeologists some years ago, but early attempts at reading them were hampered because the different languages were not sorted out. Writers of long records on the baked tablets were careful to indicate the sequence from one tablet to the next, and usually at the end of the document the author wrote his name, his profession, and place of residence, in modern fashion.—*Science Service*.

Teaching and Practicing Golf

TIMING" in golf is the basis of the expert player's art and the despair of that large group of golfers who are always striving to improve their game. This timing of a stroke, however, has heretofore been largely a matter of guess-work as to accurate measuring and resulting skillful command of it.

A device has been perfected by a New York inventor, Norman D. Mattison, which is said to give, for the first time, to the beginner as well as the advanced player, an accurate gage of this timing of golf strokes. It is used solely for practice and in teaching and is called the "Rhythm Club," replacing the usual silent practice stroking with a means for indicating stroke timing accurately.

This practice club is of substantially the same appearance and weight as an iron playing club, and has a hollow shaft to permit the movement of metal or wood disks. "Stops" may be placed anywhere along the shaft to limit the range of motion of the disks between them. The advantage of this becomes evident when the back

example, why, in view of the usage to which shovels, spades and scoops are put, should one ever consider the purchasing of polished goods, because from every standpoint from which it may be considered, the putting of a highly polished finish on these articles is unsound and uneconomical. If one ever considered the labor and expense of polishing a shovel and then its appearance within five or ten minutes after it was put in use, it would certainly seem that the usage of polished goods, with possibly one exception, is without reason.

All shovels, spades and scoops of the polished variety are made from exactly the same piece of steel as the black or natural finished tool, yet a great amount of labor is expended to produce a beautiful finish which does not last and which costs a great deal in money, and the final result is a tool the life of which has been shortened materially by the polishing process.

Originally, shovels were made of iron. Then when steel came into use, on account of objections (not sound ones, however) to the use of steel, it was necessary to polish shovels so that they would look the same as the polished iron shovel. The outer surface of any piece of metal, whether it is in the bar, sheet or cast form, is the hardest part of it, due to a certain amount of chilling and upsetting of the grain of the metal by exterior cooling in the process of manufacture. To polish this away not only means spending money for a purpose which has no commercial advantage, but actually produces an article the life of which has been materially reduced.

In the preponderant desire to simplify business, it certainly is not simplification to



The rhythm club, showing set screws of stops and disk between stops

swing is begun, the disk or disks sliding within the shaft into engagement with the stops, thus giving audible indication of the character of the swing.

The command of the back swing, especially that part of it when the hands and wrists pronate in lifting the club, is fundamental to accurate stroking. Indeed, Vardon in "Complete Golfer" states: "The upward swing is everything. If it is bad and faulty, the downward swing will be wrong and the ball will not be properly driven. That is why so very much emphasis must be laid on getting the upward swing perfect. . . . The entire movement must be perfectly smooth and rhythmical."

This rhythm club brings to golf the same factors for developing perfect co-ordination as the ones which music simultaneously develops—the three senses of sight, hearing, and touch. While rhythm and timing may be acquired without the aid of hearing, experience proves that much time and energy may be conserved by co-ordinating the three senses upon which really good golf is dependent.

A "Fad" in Industry

IT is strange, in the light of modern progress, that certain fallacies still persist in the industrial world with no more reason for their being than some fad of dress which is persistently adhered to with no better excuse than that it is "the style." For

produce a great number of special finishes for a matter of appearance only. A polished tool when put into use, by the natural



In action, the disk drops by gravity and the click caused by contact with the stop near the handle end times the upward swing



Facts about Ethyl Gasoline

ETHYL GASOLINE was developed by General Motors Research to provide a more efficient fuel for internal combustion engines.

It is formed by adding Ethyl brand of anti-knock compound ("ETHYL" fluid) to selected motor gasoline in an amount sufficient to utilize the higher compression created by carbon deposits or advanced engine design.

"ETHYL" fluid is a concentrated liquid containing tetraethyl lead which has the property of controlling the combustion rate of gasoline. It is a patented product.

Only oil refining companies licensed to sell Ethyl Gasoline can mix "ETHYL" fluid with their gasoline. In every case the amount of "ETHYL" fluid must be sufficient to meet a definite standard of "anti-knock" quality rigidly controlled by the Ethyl Gasoline Corporation.

Ethyl Gasoline is colored red for identification. The color has nothing whatever to do with its performance. It takes more than dye to make "anti-knock" gasoline.

Ethyl Gasoline increases the performance of any automobile engine—whatever its compression—whatever the climate or other driving conditions.

If your car is designed to operate

on ordinary gasoline, the use of Ethyl Gasoline will:

Eliminate "that knock" and power loss.

Make carbon deposits a source of extra power. For carbon increases compression and Ethyl Gasoline is the high compression fuel.

Give a smoother and better pulling engine, particularly on hills and heavy roads.

Reduce gear-shifting and increase acceleration, thereby making traffic driving easier.

Cut down vibration, thereby reducing engine wear and tear and depreciation.

Save you the expense of carbon removal and other repairs caused by "knocking" and carbon formation.

Give more power per gallon for your fuel bills—and more mileage as compression is increased by carbon deposits.

If your car is a high compression car, just remember that Ethyl Gasoline made it possible and its use is necessary to obtain maximum performance.

Ethyl Gasoline is sold only at pumps which display the "ETHYL" trademark shown above.

Ethyl Gasoline is the yardstick by which other gasolines are measured.

More than a million are riding with ETHYL

IT took seven years to develop Ethyl Gasoline—but it took only months for the motoring public to discover its advantages.

Today more than a million car owners are riding with Ethyl. They are enjoying a new standard of engine performance—more power on hills and heavy roads, faster pick-up, reduced gear-shifting, a cooler, smoother motor under all driving conditions. And to the owners of the new high compression automobiles, Ethyl is giving a still bigger thrill.

Follow the army of Ethyl users to the nearest Ethyl pump. It is identified by the trademark shown above. And the price of Ethyl Gasoline is simply the price of good gasoline, plus the few extra pennies the "ETHYL" ingredient costs.

Ethyl makes good gasoline better.

ETHYL GASOLINE CORPORATION
25 Broadway, New York City

ETHYL GASOLINE

process of rusting, will wear away quicker than a black or natural finished tool, and it would therefore seem axiomatic that polished goods should be discarded entirely, with the exception of the foundryman's moulder shovel.

Why follow a "fad" when black goods cost less and wear longer?

Car Owners Can Save Millions

AMERICAN automobile owners can save 400,000,000 dollars annually by using engines that operate at a constant instead of a variable pressure, Prof. H. M.



Weidled section of plate bent to show strength of weld

Jacklin of Purdue University has reported to the Society of Automotive Engineers.

Present auto engines operate so that the volume of the gaseous fuel exploded is constant. Prof. Jacklin's experiments were made upon an experimental engine constructed with a movable cylinder-head that was used to reduce the volume of the cylinder as the speed of the engine decreases. This maintained the same pressure within the cylinder at all speeds. No adjustment of spark was necessary.

Gains of up to 50 percent in miles per gallon might be expected if the new type engine were substituted for the ordinary engine now in use. Fuel bills would be cut by one third, according to Prof. Jacklin's computations. Assuming a complete substitution of the constant compression engine in the 20,000,000 cars now running 6000 miles a year on 20-cent-per-gallon gasoline, Prof. Jacklin sees the possibility of conserving our natural resources and the national pocketbook to the extent of some four hundred millions of dollars annually.—*Science Service*.

Welds of Extreme Ductility Produced by New Process

THE "electronic tornado," which was developed in the research laboratories of the Lincoln Electric Company, Cleveland, Ohio, about 12 months ago, and which is based upon an electric phenomenon which was originally considered to have only scientific interest, has been further developed so that its commercial application is assured.

Not only are the welds produced by this new process far more uniform in structure and ductility but reports state that the cost of welding is but a fraction of the cost by present-day methods.

Heretofore, metal deposited by electric arc welding has partaken of the characteristics of cast steel. Tests of this new process show that the metal deposited in

the weld has equal or even better physical characteristics than the metal of the plates joined by welding. This is a result of the purifying effect of the electronic tornado.

An incidental advantage of electronic tornado welding is the smooth finish which is obtained on the welding bead. This in part is caused by the higher speed of travel of the welding heads and is in part inherent in the new process.

Commenting on micrographs that have been made of welds produced by this process, the metallurgist who made them reported: "Comparing the new process structure to that of the raw steel, you will note that these structures are generically the same, the grains being more or less rounded in general contour.

"As a generality, the structure of this new process sample is very similar to that of a highly refined low-carbon steel, a condition brought about in such steel by a suitable heat treatment."

Actually, an electronic tornado weld is heat-treated steel and for that reason is free from undesirable hardness. Its great



In tension tests, welded bars never broke at the weld

ductility is evidenced by the test pictures in the accompanying illustrations. The refining effect of the new welding process is said to produce weld metal fully as good as that which can be obtained in rolled steel of the same general purity.

City Death Rate Lower

DEATH rates in the city are now lower than they are in the country because preventive health measures in cities reach and benefit a larger proportion of the inhabitants than is the case in rural areas.

This observation was voiced by Dr. Henry F. Vaughan, health commissioner of Detroit, at a recent conference for race betterment at which measures for the improvement of the human race were discussed by physicians, health workers, statisticians and research men of many branches of science.

Altering the immediate environment under which man lives may affect whole communities, Dr. Vaughan pointed out.

For example, the substitution of a pure water supply of a city for a polluted one protects all its citizens, although thousands may be wholly ignorant of what has been done.—*Science Service*.

New Neon Light for Aviation

FOG, one of the greatest hazards to aviation, may lose some of its dangers in the near future as the result of the development of a new type of quartz neon gas-filled lamp by research engineers of the General Electric Company. This lamp, which resembles a ball of reddish orange fire when in use, emits practically all its visible radiation in the long wavelengths, which tests have shown to have greater fog-penetrating power than light higher in the spectrum.

It was found that during a heavy morning mist, when the laboratory building in which the new lamp was housed could not be seen 500 feet away, the brilliant red glow penetrated to a distance of half a mile or more. In discussing the possibilities of neon light for aviation purposes, C. G. Found, who developed the new lamp, said:

"We do not know yet how far this red light can be seen. However, a neon lamp of earlier type with but half the candlepower, was reported seen by an aviator on a clear night at a distance of 75 miles. We are going to place this new light and one of the standard white light airport beacons on the roof of one of our tall factory buildings in Schenectady. In this way we hope to learn from direct visual tests just how much of an advantage the neon light has in bad weather. We think that, because of the contrast in color, the red light will be helpful to aviators in more easily picking up guiding beacons and landing fields at a distance."

Quartz is used in the lamp because of the heat generated in its operation. The temperature is about 1200 degrees, Fahrenheit, which is above the fusion point of glass. Quartz, however, will stand tem-



C. G. Found and his newly developed hot-cathode neon light

peratures up to 2000 degrees, Fahrenheit, before beginning to soften.

Another feature of the new lamp is its operation on low voltage, substantially that used in household service. Previous types of neon lamps required very high voltages, often as high as 15,000 volts, to enable them to produce sufficient candlepower to make them useful. Such voltages are not only dangerous unless carefully guarded, but require special equipment to produce.

(Continued on page 369)



TO go on working mile on mile, day after day, capacity loads, all roads, all weathers . . . to do this with sunrise certainty year upon year requires unusual stamina.

That sort of stamina in Graham Brothers Trucks and Commercial Cars—all sizes, from $\frac{1}{2}$ -Ton to 2-Ton—is being proved constantly on the roadways of the world by just such performance. Combine with this stamina the

power, the speed and the operating economy to which hundreds of thousands of owners bear witness.

Know that service, though seldom needed, is available from Dodge Brothers dealers—always and everywhere.

Know that the prices are extremely low, due to great volume production. Then let your local dealer show you the right type—body and chassis—for your business.

2-TON . . . \$1595
6-cylinder engine, 4-speed transmission, 4-wheel brakes (Lockheed Hydraulic)

1½ TON . . . \$1245
4-cylinder engine, 4-speed transmission, 4-wheel brakes (Lockheed Hydraulic)

1-TON (G-BOY) . . . \$895
¾-TON COMMERCIAL . . . \$670
Chassis Prices f.o.b. Detroit

½-TON Panel DELIVERY CAR \$770
(Complete with body f. o. b. Detroit)

GRAHAM BROTHERS TRUCKS

Sold and Serviced by
Dodge Brothers
Dealers Everywhere

Built by
Truck Division of
Dodge Brothers, Inc.

Learning to Use Our Wings

This Department Will Keep Our Readers Informed of the Latest Facts About Airplanes and Airships

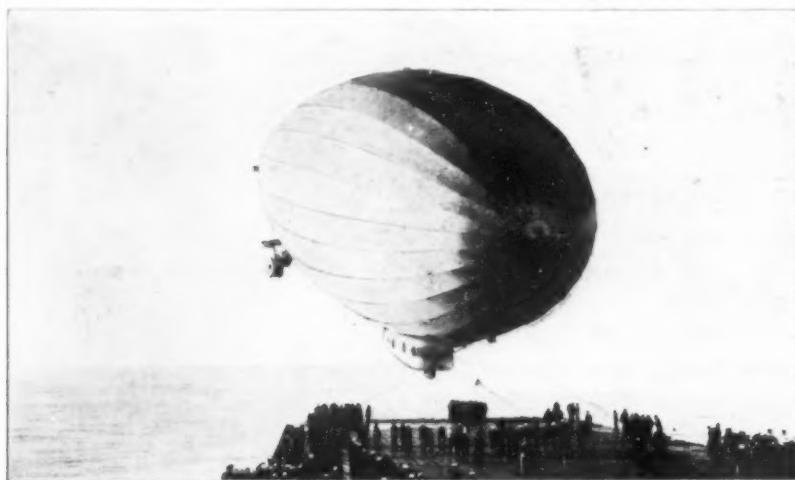
CONDUCTED BY ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York City

"Los Angeles" Lands on "Saratoga"

THERE is no doubt that the recent exploit of Lieutenant Commander Charles E. Rosendahl in landing the *Los Angeles* on board the deck of the new aircraft

Saratoga when holding the lines. A sudden side gust might have thrown them overboard. Fortunately, nothing of the sort happened, and hastily devised equipment sufficed to fasten the airship down securely. The get-away was made with ease and the



The airship *Los Angeles* landing on the broad deck of the *Saratoga*

carrier *Saratoga* increases both the cruising radius and the general utility of the rigid airship. The airship can be refueled while attached to the carrier, and repairs of some magnitude can readily be carried out. Moreover, the process of landing seems to be much easier, and the subsequent attachment less dangerous, than the mooring to the mast of the *Patoka*, the previous exploit of the Navy along these lines.

No official report of the experiment is yet available. Navy authorities indicate that the following procedure was adopted:

The *Saratoga* was at sea about 30 miles south of Newport News and headed into the wind at a moderate rate of speed—about 15 miles an hour. The *Los Angeles* made one practice approach from leeward to one side of the carrier at an altitude of about 225 feet. Then it circled and made the approach for landing. The wind was light but very gusty, so that the airship was lifted to 400 feet before making the landing. By delicate maneuver the airship was finally brought down so that its bow was just aft of the funnels and mast of the carrier. The *Saratoga* measuring only 850 feet on its flying deck, and the *Los Angeles* having a length of 680 feet, this meant that the stern of the airship was far behind the stern of the surface vessel. Nosing down gently, the airship came to a stop with its control cabin just touching the deck or just clearing it. To bring the airship into alignment, a line was thrown from the bow of the airship, and two more lines were flung from its sides. This operation was not without some danger for the enlisted men of the

Los Angeles returned to Lakehurst without any mishap to mar the experiment's success.

It is another proof of the ease of maneuver now attained by the airship that an Army blimp or small non-rigid airship recently landed on the roof of a high school at Newport News, Virginia.

Architecture and Airport

WE are apt to think of an airport as a large landing field with a group of

ugly looking hangars at one end, a runway or two and a system of lighting.

This may be true for the United States, but is no longer true for Europe. In Europe, passenger flying is already well established and passenger traffic brings with it certain problems for the airport.

At Croydon, London's large airport, the administration buildings and hangars have been completely rebuilt. The former have, as a matter of fact, been brought together into one large and fairly pleasing structure.

In Germany, when the Stettin Airport Corporation started its plans, it called for competitive designs from local architects. The prizes for these designs ranged from 1000 to 3000 marks, which does not seem very high to us. But the designs produced were architectural compositions quite as pleasing and as well thought out as those for a great railroad station.

It is curious to note the points on which the judges of the competition laid stress in making their awards. They were: Ready access from the street; Complete visibility over the field, particularly in the operations towers; Separation of visitors to the station and actual travelers; Provision for restaurant and cafes; Good architectural ensemble; Cheapness of construction.

The plans submitted made a harmonious whole out of the accommodations for passengers, administration offices, hangars, workshops and so on. There is no doubt that American architects will soon find equally interesting problems in airport design.

The Sikorsky Amphibian

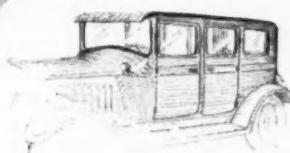
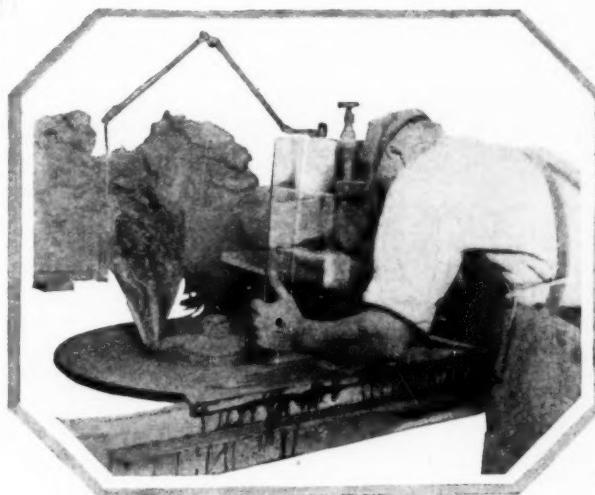
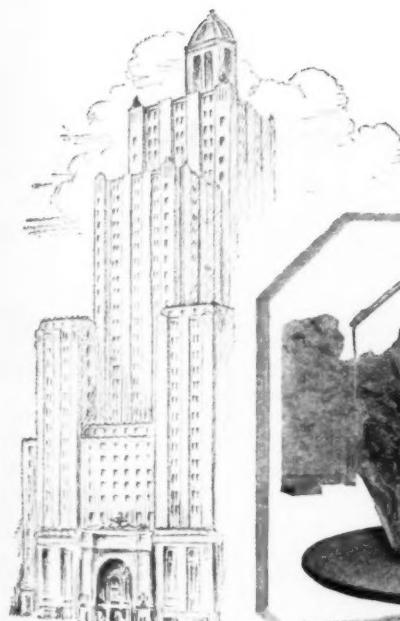
ONE of the most interesting American planes of recent times is the Sikorsky amphibian, the S-36, built to carry a pilot and seven passengers and equipped with



International Newsreel

The well designed airport at Croydon, England

*And for
Glass Grinding,
too-*



Norton Abrasives

Another commodity dependent on modern abrasives is plate glass—so widely used in show cases, store windows, automobiles and countless other places. For edging and beveling plate glass Alundum grinding wheels and Alundum and Crystolon abrasives in grain form are effective agents.

Also in the manufacture of articles of glass—tumblers, knobs, cut glass ware, lenses and the like—these Norton electric furnace products are important factors.

The glass industry is but one of many served by the electric furnace. Norton abrasives are used throughout the world as the basic factor in grinding wheels and other forms of grinding tools, and in refractories and non-slip floors.

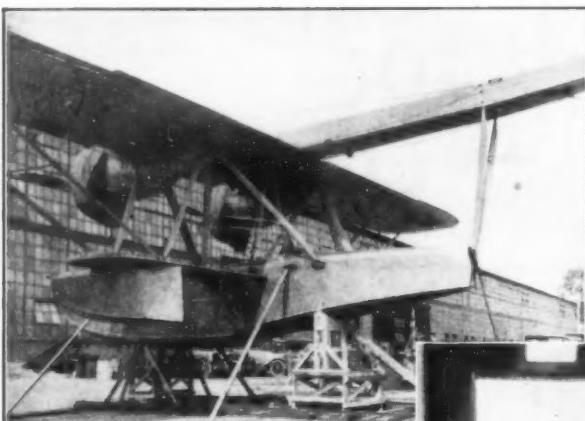
NORTON COMPANY, WORCESTER, MASSACHUSETTS

NORTON

Grinding Wheels
Grinding Machines



Refractories—Floor
and Stair Tiles

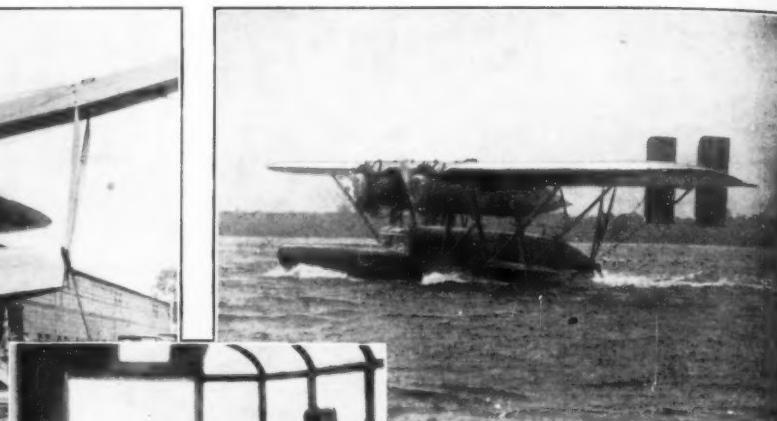


The S-36 in process of construction. The tail surfaces are supported by an outrigger from the top wing

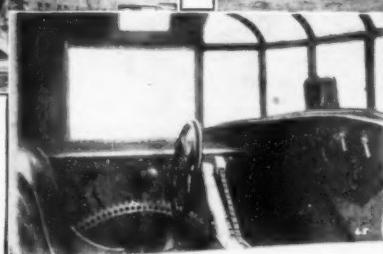
two Wright "Whirlwind" engines. With gas and oil for four hours, its gross weight is 6000 pounds. The wing area is 585 square feet; high speed, 100 miles per hour; climb, 600 feet per minute; and the "ceiling" is 15,000 feet.

In the enclosed cabin type, the pilot's cockpit, with dual side-by-side control, is in the front upper part of the cabin. Behind the cockpit are two seats, facing one another and each comfortably accommodating three passengers.

With a normal useful load of 2000 pounds, the plane flies on either of the two engines without losing altitude. Sikorsky has always been interested in the problem of flight on one of two engines, and he has designed very carefully to this end. The engines (as can be seen from the photographs) are placed quite close together, so that the eccentric thrust moment of one engine is reduced to a minimum. A very ingenious form of rudder control also contributes to the possibility of single engine flight. The two fins and the two rudders present a flat surface on their outboard sides, and a cambered surface to one another. If one engine only is functioning, the fin and rudder in the slip-stream of the active engine automatically produce a lateral force which compensates for the eccentric moment.



The Sikorsky amphibian taking off from the water. Note the wheels retracted to the streamlined hull



Interior of the cockpit, with dual controls. Vision in all directions is had through ample windows

Airplane designers are keenly aware, from the point of view of seaworthiness, of the advantage to be gained from a large water displacement. The water displacement of the hull of the S-36 is actually 17,670 pounds, or nearly three times the normal gross weight. The hull has beautiful lines, with a 12 degree "V" at the bottom, and is only 26 feet long. It is built of varnished duralumin sheets screwed to a hardwood frame. The hull is divided into many water-tight compartments by sheets of duralumin. These duralumin partitions are so arranged that, by removing a few bolts, it is easily possible to crawl into the hull to inspect or repair the structure. The bow of the hull is provided with an opening through which the pilot can drop anchor or effect a mooring when the boat is afloat.

In the design of flying boats, it is always a problem to support properly the tail surfaces. It is necessary to hold them far up out of the water. If they are carried at the end of the hull, its length and weight

become large; its rear portion curves upward to the detriment of aerodynamic efficiency. Sikorsky meets the difficulty by carrying a species of outrigger from the top of the wing, built up like a fuselage of four longerons and the necessary cross bracing.

There is no doubt as to the flexibility and utility of the amphibian principle. In the S-36 the wheels are retracted by a very simple mechanism, and while they are not hidden in flight, they are so carried in water work as to be entirely above the spray.

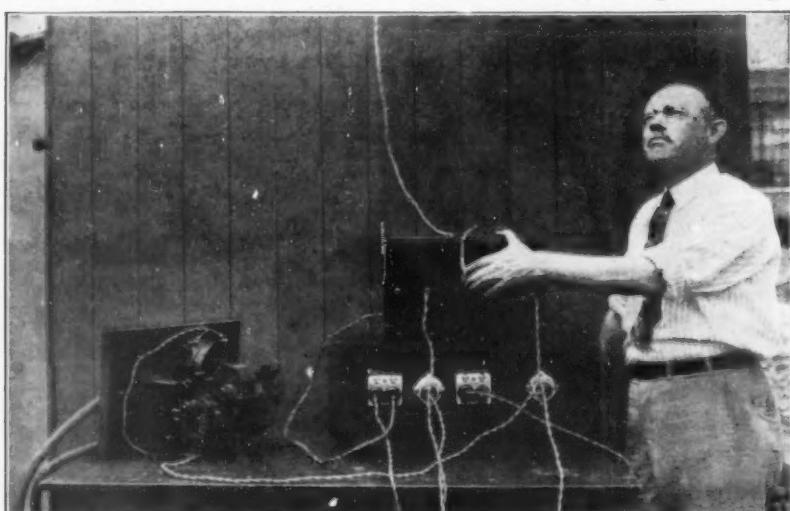
We are also emphasizing the desirability of metal construction of aircraft. The only reason why metal wing construction is being retarded is its cost, a question of paramount importance for commercial aircraft. In the S-36 a very simple, although light construction, has been developed. The spars consist of two main members of "T" section, commercially obtainable in rolled form, the lower "T" being inverted with the stem of the "T" upwards. The stems of the upper and lower "T" section members are joined by diagonal members riveted into place by a single rivet at each end, and making the spar into the familiar Warren truss. There is nothing alarming to the shop or the finances of the constructor in such practice, which is merely an application to aircraft of the well-known principles of bridge construction.

Automatic Airport Lighting

THE Westinghouse Electric and Manufacturing Company has recently perfected an automatic device which utilizes the hum of an airplane engine to close the circuit of an airport illumination system. The device is so sensitive that it functions when the plane is still 1500 feet above the field, yet has such selective qualities that it will not respond to any sound other than that of the airplane engine.

The device consists of a microphone, resonant and amplifying circuits, a time element relay, and contactors. The hum of the engine is picked up by the microphone which is mounted in a vertical position so that it will best catch sound waves from the air above. The current thus induced in the microphone circuit is transmitted to a resonant circuit tuned to the frequency of the hum of the engine, where it is amplified many times. The tuning of the resonant circuit eliminates such sounds as voices, automobile engines and horns.

(Continued on page 378)



Courtesy Westinghouse Electric and Manufacturing Co.
Thomas Spooner, inventor of the device for automatically lighting airports when an airplane nears the field, is shown here with the apparatus

Office heat . . . chilly street . . . sore throat!

From over-heated offices into chilly streets . . . out in the cold waiting for transportation . . . into germ laden cars crowded with coughers . . . is it any wonder thousands are laid up with colds or sore throats—or worse?

Don't be one of them. After exposure of this kind, gargle with Listerine when you get home.

Better yet, use it systematically

night and morning during nasty weather. It may be the means of sparing you a long, painful and costly siege of illness. Many a cold weather complaint has been checked by Listerine before it had a chance to become serious.

Being antiseptic, it immediately attacks the countless disease-producing germs that lodge in mouth, nose and throat.

Again, we counsel you for your own protection to use this safe antiseptic twice a day, at least, during inclement weather. Lambert Pharmacal Company, St. Louis, Mo., U. S. A.

Gargle when you get home



LISTERINE

-the safe antiseptic

Industries From Atoms

A Department Devoted to the Advancements Made in Industrial and Experimental Chemistry

WITH this issue, we are glad to welcome our new chemistry editor. In the future, this department will be conducted by Mr. A. E. Buchanan, Jr., Assistant Editor of *Chemical and Metallurgical Engineering*. Mr. Buchanan is also Assistant Secretary of the American Institute of Chemical Engineers.

The Editor.

Synthetic Ammonia

AMMONIA synthesis for the first time indefinitely postpones the limitation of the human race by starvation, according to Louis C. Jones, of the Nitrogen Engineering Corporation, New York, discussing nitrogen fixation through ammonia synthesis before the Institute of Chemistry of the American Chemical Society.

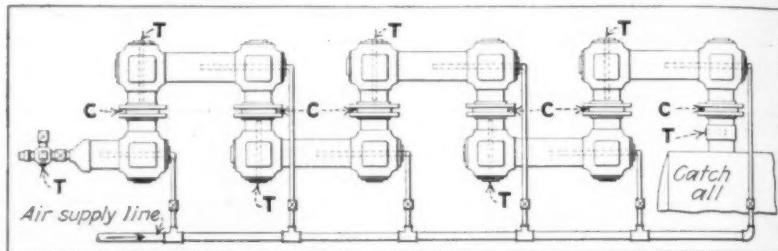
Commercial developments of the synthesis of ammonia have proceeded so far in Germany, England, Italy, France and the United States that the infinitely huge stores of nitrogen in our atmosphere can now be confidently relied upon to furnish unlimited quantities of this necessary constituent of fertilizer essential to continued agriculture, Mr. Jones stated.

"Fears that the exhaustion of Chile's natural deposits of nitrate, agriculture's sole dependence in the past, would so limit food production that the race would starve, have been completely dispelled by the latest industrial developments of the catalytic chemical process discovered by

are perfecting the solution of industrial nitrogen fixation, a generation ago considered the limiting factor to the earth's inhabitants."

"The process of ammonia synthesis,

to permit of its use with economy for synthetic ammonia manufacture. In Iceland, Greenland, Labrador, Africa and similar remote places, electrolysis of water for hydrogen can be utilized for synthetic



The latest denaturant for alcohol, to prevent its use for illicit beverage purposes, is "aldehol." The above equipment is used for making it

discovered by Haber and now so widely applied, consists in passing a pure mixture of nitrogen from the air and hydrogen obtained from water over a catalyst, consisting of iron and certain added impurities, called promotor, at high pressures and temperatures. Nitrogen as it exists in the air is useless but when it has once been made to combine with hydrogen or any other element, it becomes invaluable. Hydrogen is to be had in unlimited quantities by the decomposition of water either by the electric current or by passing it over hot coke.

ammonia manufacture. The only requisites are cheap power and low ocean freights."

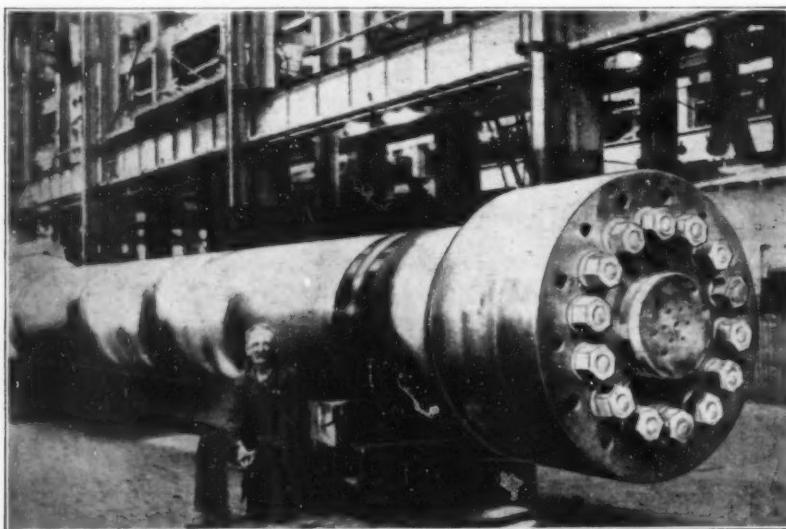
Baffling the Bootlegger by Catalysis

ALTHOUGH he may not know what the word means, the bootlegger who produces his "pre-war stuff" by removing the poisonous denaturant from denatured alcohol, is soon to be embarrassed by a new application of catalysis. A denaturant, known as aldehol, is now being produced by a catalytic process.

When the bootlegger gets his first shipment of illegally diverted alcohol which has been denatured by the addition of aldehol, its odor is likely to discourage him from further activity. Even if he plugs up his nostrils and does his best to separate the alcohol from the odor he is doomed to further disappointment, and his thirsty customers will firmly decline to risk the aggravated halitosis that is promised by the evil aroma of the synthetic "hootch."

From the above it may be correctly inferred that aldehol has a persistent, penetrating, and decidedly unpleasant odor. But it has another valuable property as a denaturant, in that it cannot be removed from alcohol by distillation or chemical methods, as is the case with many more common denaturants. This is because aldehol is not a definite chemical compound, but a mixture in which one seems to vie with the other in offending the olfactory nerves. The insidious danger of synthetic liquor lies in the fact that the consumer can not tell whether or not the maker has successfully removed all the poisonous denaturant, such as wood alcohol, until he has suffered its painful effect. If, however, the denaturant is aldehol, his "nose will know."

The newly developed process for the manufacture of aldehol is of great interest, for it may be varied to produce a wide variety of useful solvents by the catalytic oxidation of hydro-carbon oils. Catalysis is the process of greatly increasing the velocity of a chemical reaction by the mere presence of a substance (the catalyst) which is itself unchanged at the end of the re-



Immense forgings such as this have been developed to supply the needs of the rapidly growing industry of ammonia synthesis, described above

the German chemist, Haber. All credit to him!

"Ten modifications of Haber's original fundamental discovery are in large scale operation today and the essential knowledge of the details of carrying out the process are known to many groups who

"Where hydro-electric power is cheap, that is, remote from industrial and utilities' demands, hydrogen can be produced by electrolysis of water. These conditions are found especially in Norway—and to some extent in Italy. Muscle Shoals' power has a value too great in its locality

action. In the present instance, kerosene is completely vaporized by heating, and the gas passed through the catalyst which causes the hydro-carbons of the kerosene to combine with oxygen, producing aldehydes, esters, alcohols, ethers, and ketones in the indefinite mixture which has been named aldehol.

The apparatus used in the first commercial scale plant for the oxidation of gaseous hydro-carbons was recently described by Dr. J. H. James at a meeting of the American Institute of Chemical Engineers. The plant has a capacity of 4000 gallons of kerosene per day. It can also handle higher boiling fractions such as gas oil and spindle oil.

The oxidation is carried on in four identical units, each handling 40 gallons of kerosene per hour. The oil first passes through a venturi-type meter with a block-tin throat. From the flow-meter the oil passes into a Foster oil-heater which in this case is really a tube still. Here the oil is completely vaporized and superheated to between 350 degrees and 375 degrees, Centigrade. In the case of heavy distillates, steam is admitted to complete the vaporization at this temperature. From the vaporizer the oil passes to the oxidizer, or to prevent the oxidizer from being flooded during heating up, it may be bypassed directly to the condenser.

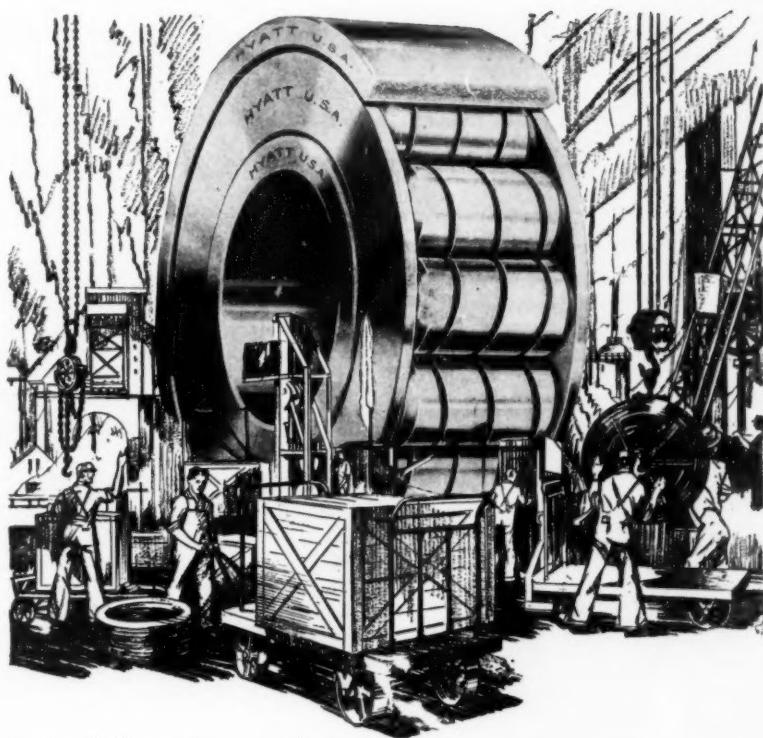
The oxidizer is made up almost entirely of standard six-inch pipe and fittings as can be seen from the drawing. The nipples between the screens do not present sufficient cooling surface to dissipate the heat of oxidation, so these were equipped with spiral fins. C is a casting which holds the catalyst screen in place. One-inch valves are used to admit air for the oxidation and it can be noted that the air really passes well back into the nipple so that it becomes thoroughly mixed with the oil vapors before passing the catalyst screen. The amount of air admitted is regulated to give a temperature to the vapors after passing the screen of 410 degrees, Centigrade. The finned nipples cool the vapors again to 350 degrees and the heat of reaction again brings them back to 410 degrees, Centigrade. The oxidizers were built for six screens but it was found necessary to use only four.

The oil vapors then pass to a tubular condenser. The condenser tubes and tube sheets are of aluminum as this seems to withstand best the corrosive action of the organic acids produced. The condensed vapors then pass to a central receiving tank for all four units. The main receiving tank is maintained under a 15-inch vacuum by two Number Three Nash Hytor vacuum pumps. The amount of air consumed is about 160 cubic feet per minute per unit at atmospheric pressure.

From the main receiving tank the oil is pumped to a settling tank 12 feet high by six feet in diameter. It takes about one hour to settle out the water formed in the oxidation. This is drawn off and the oil pumped to a storage tank for further treatment.

As showing the possibilities of this process, it has been demonstrated that by oxidizing three cuts, naptha, kerosene, and wax distillate, nitro-cellulose solvents distilling through the whole range of "low boilers," "medium boilers," "high boilers," "plasticizers," and "softeners" can be made. These solvents are mixtures of inner esters, ordinary esters, alcohols and ethers.

(Continued on page 372)



All industry moves faster . . . on Hyatts

Hand trucks, lift trucks, trailers, conveyors, hoists, cranes—everything by which materials are lifted and moved from one operation to another—can either retard production or increase its speed. Such equipment must move easily and quickly, with a minimum of man power or motive power, else profits are seriously affected.

The use of Hyatt Roller Bearings greatly reduces friction and allows, permanently, the more economical operation wherever installed. Leading manufacturers of material handling equipment long ago discovered that by standardizing on Hyatts their products would last longer and require less maintenance.

To reduce manufacturing costs as well as to speed up production, factory executives should see to it that their machines and their material handling equipment are free-running on Hyatt Roller Bearings.

HYATT ROLLER BEARING COMPANY
Newark Detroit Chicago Pittsburgh Oakland

HYATT
ROLLER BEARINGS

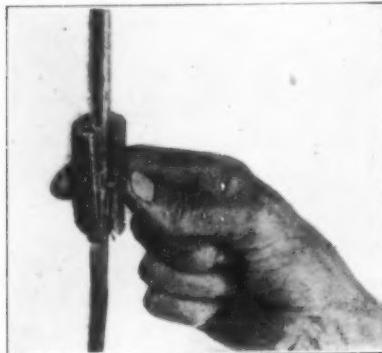
PRODUCT OF GENERAL MOTORS

Applied Science for the Amateur

*A Department Devoted to the Presentation of Useful Ideas.
Material of Value to All Will Be Found Here*

To Polish Small Tubing

POLISHING small brass or copper tubing can be easily and efficiently done as shown in the photograph. Take a short length of steam or air hose, the inside of which is of a diameter nearly that of the outside diameter of the tubing. Slit the hose, removing a segment equal to about one eighth of its circumference. Lay in the



Polishing copper tubing is rendered easy by the method shown above

emery cloth or paper as shown; slip the two over the tubing, pinch lightly and go after the corrosion.

The hose gives the cloth a much better bearing or contact area, and a far better grip is afforded, as the cloth in contact with the rubber does not slip or work out. A real job of polishing can be done easily and on a lot of tubing in this manner.—
Contributed by F. B.

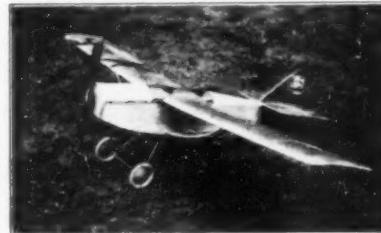


In order to prevent oil from the tip of an oil can from flowing down the spout and over the can itself, the illustrated idea may be employed. A spiral spring is placed over the spout and the space between is packed with waste. *F. W. Bentley, Jr.*

Our Readers Contribute

SINCE we started the publication of information on the construction of model airplanes, we have found that many of our readers are interested in the subject as a hobby, and furthermore, that there are not a few who have been working along the same lines for some time past.

We offer to publish photographs of models made by our readers and on



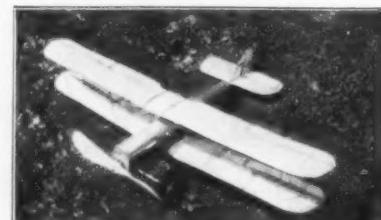
them was illustrated in this department in the last issue. This month we print photographs of two more models. The topmost and center illustrations in this column depict a two-seater sport-model monoplane constructed by Charles Kren of Cleveland, Ohio.

This model is capable of taking off from the ground, and launched in this way has made successful flights of 60 feet. It is, of course, propelled by rubber bands. It has a wing spread of 34



inches, a chord of five and one quarter inches, a ten-inch propeller and weighs only eight ounces.

The lower photograph in this column shows a model biplane, of the De Havilland type, constructed by Lloyd McCarthy of Potsdam, New York. This model has a span of 36 inches, uses a 12-inch propeller, and is equipped with one-inch aluminum wheels fitted with rubber tires. The fuselage is covered with a very thin veneer, while a tiny aluminum radiator adds to the realistic appearance of the model.



Scale and Hydro Model Airplanes

THE making and flying of scale-model airplanes is very interesting because during their construction, their maker learns many details about man-carrying aircraft and when, in addition to its attractive appearance, the model also possesses the ability to fly, the "thing of beauty becomes a joy forever." There are many descriptions of scale models and instructions for making them, which are easily available to model makers throughout the country. Therefore this item will confine itself to a few remarks upon the subject.

The drawing shows a general type of scale-model fuselage. The shape, of course, would vary in various instances to correspond with the original. The general procedure in making a scale-model fuselage is to build it up by longitudinal strips and short upright struts. For a three-foot model, the size of wood for these strips and struts is about one eighth of an inch square. The drawing illustrates a method of attaching the chassis and tail skid. The latter may be pivoted to the rudder post extension and fastened at its upper end with a rubber band so that it will cushion the shock of landing.

The chassis struts may be fastened to the fuselage with small tube fittings and may be one continuous U-shaped piece or joined at the bottom with a "V" fitting as suggested in the article on fittings. The problem of installing a rubber motor in a scale model is sometimes a complicated one, due to the inaccessibility of the rubber in the enclosed fuselage. Not only does the enclosure make them difficult to install and repair, but occasionally during winding the rubbers will break and their consequent recoil often damages the fuselage itself.

An excellent method of overcoming these faults is as follows: instead of having the propeller shaft fastened in the ends of the fuselage and the tail hood secured to the rudder post—a method which has the above disadvantages and also frequently results in distortion of the flying surfaces when the rubbers are wound—the power plant is made one complete unit including the nose of the model. The rubbers are strung along a motor stick which absorbs the twist of the rubbers without distorting the rest of the fuselage.

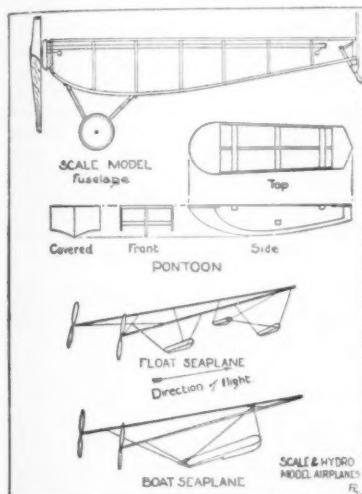
This power-plant assembly can be removed from the rest of the model for adjustment and can then be wound by means of a geared winder. It is made detachable through the use of dress clips of the snap type. These can be bought at notion stores in various sizes and can be fastened to the model itself either with wire or small nails. Some model makers who might not care to adopt this method and yet have the choice of a detachable power plant may originate wire clips or other original fittings for accomplishing this same purpose.

The method of attaching the wings to the fuselage is the same as is used for large machines, and the construction of the wings themselves is similar to the methods used for other models which have been described

in previous articles. Should the model maker desire plans and specifications for particular models, these may be procured in many varieties. A stamped, self-addressed envelope will bring details.

Hydro Airplane Models

THE flying surfaces and power plants of hydro models are similar to those of other scientific models, and in addition, floats are attached to enable the model to take off from and alight on the water. Floats, or pontoons, may be of various patterns. An efficient type is shown in the drawing. Four views are included which readily explain the construction. The size of the pontoon will vary with the size of the model to be supported, but as a guide, it can be said that three pontoons of the above

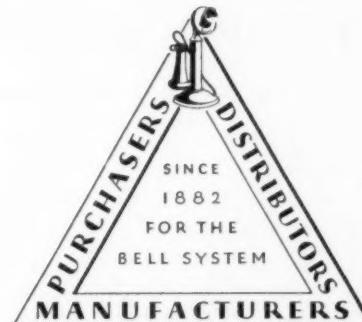


Details of the scale and hydro model airplanes described in this column and on the opposite page

pattern, five inches long, will support a three-foot scientific model. These pontoons may be grouped with two in the front and one in the back, or vice versa. The drawing suggests an arrangement of two in front and one in back, because this gives the most stability in taking off and landing. The struts should be of bamboo and in addition to the bamboo parts, bracing wires may be used. In the drawing, the wings and some other parts of the model are left out in order to show the pontoon arrangement to better advantage. Small wing floats are used to balance the model.

The bottom drawing shows the type of hydro model known as a boat seaplane in which one large pontoon takes the place of several smaller ones. This class has often demonstrated its ability. It is customary when employing a large float to put a step in the under surface to decrease the drag of the water. This feature follows standard hydroplane practice. The construction of this large pontoon may be similar to that suggested for the small pontoons with the addition of the step.

In preparing models for taking off the water, more power is required than for hand launched models; therefore it is customary to obtain this power by increasing the number of rubber strands and stringing them tighter. There is a novel pleasure to be obtained from hydro airplane flying that is not a part of other branches of the sport.—Courtesy *Playground and Recreation Association of America*.



GOING HERCULES ONE BETTER

It is not on record that among the labors of Hercules he faced any so hard as this:

To make every year a million telephones, thousands of miles of telephone cable using more than 35 billion feet of wire, and over 100,000 items of various kinds of telephone apparatus to meet the nation's communication needs.

What this company does not make for the Bell System it must supply as the System's purchasing agents. To buy poles by the forest, construction material by the trainload, involves an activity which covers nationwide and even worldwide markets.

Western Electric not only makes or buys substantially everything the Bell System uses but it also stores and distributes this material from centrally located warehouses. Your telephone company, for its regular needs or for emergency requirements after some destructive storm, looks to Western Electric for prompt delivery.

To this threefold responsibility Western Electric brings an experience ripened through two generations and an abiding purpose to make the services of supply worthy of the highest ideals of telephone service to the public.



Western Electric

Purchasers... Manufacturers... Distributors



Strays From the Ether

A Monthly Review of the Progress Made In All Branches of Radio Communication

Transmitting License Fee Proposed

THE present government administration of the radio law requires a separate appropriation. In order to make this department self-supporting, it is said that Senator Dill expects to introduce a bill in the upper house calling for an annual license fee from each broadcaster of \$500 dollars a year. Such a licensing arrangement has been spoken of in the past but the question has never yet been put up to Congress.

Senator Dill, who states that he does not expect to endorse such a bill at the present session, realizes that this licensing procedure will mean a revenue of only about 300,000 dollars a year, but he argues, and quite rightly, that this figure will at least pay for the expenses incurred in administering the present radio laws.

Aviation and Radio

AFTER a survey conducted during the last year, the American Telephone and Telegraph Company made the following announcement relative to radio communication along airways and to airplanes:

"It is evident that the country is now in the midst of a vigorous development in this new field of transportation. So far as the engine and the airplane are concerned, a commercial degree of safety and reliability is attainable in the present state of the art, and while further improvements in design are certain, no fundamental invention in the airplane itself is required for its utilization for air transport devices.

"The greatest need is to increase the reliability of transportation and safety of passengers. Such safety can be increased by minimizing the hazards of weather and the risk of losing the true course along an

airway, and by the use of a dispatching system analogous to modern railway practice, but certainly very different. For all of these purposes, electrical communication systems will be required, using both wire and radio.

"The Bell system provides a nation-wide communication service and is working on the new apparatus and equipment necessary to extend communication service to airways and aviators as and when required. The problem is at first one of research and development, and the Bell Telephone Laboratories have, therefore, included in their 1928 programs a substantial amount to be devoted to the advancement of safety in aviation by the application of electrical communications."

Greenwich Mean Time by Radio

GREENWICH mean time from the Royal Observatory is now broadcast twice daily by the British Station GBR, at Rugby, England, operating on the 18,740-meter wavelength.

Each morning at 4:55 o'clock, Eastern Standard Time, and at 12:55 P.M., Eastern Standard Time, without any warning except a few moments' silence in the commercial traffic, Rugby transmits the time signals on the minutes, and after the last time signal the station reverts to its normal working.

Daylight Effect on Short Waves

TESTS by Marconi reveal that for long distances the daylight range steadily increases as the wavelength is reduced below 92 meters, the 32-meter wave being used with ease all day at Beyruth, Syria, from England over a distance of 2100

miles, while the 92-meter begins to fail over this track during daylight at a distance not much in excess of 1000 miles.

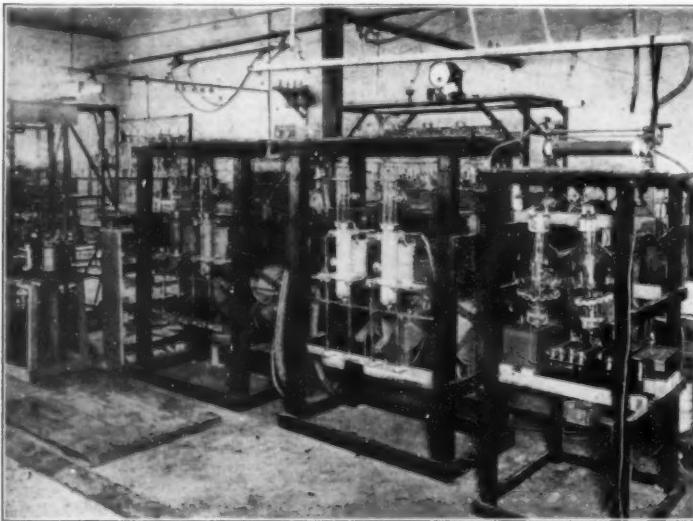
During these tests the 60-meter wave appeared to be slightly better than the 92-meter during daylight, the 47 still better and the 32-meter very much better.

From the results of these experiments it was naturally presumed, and later experience confirmed Marconi's anticipation, that still shorter wavelengths would show still greater daylight range and further tests proved this and also showed that very short waves, while being capable of working over the greatest distances during daylight, had but a comparatively short and unreliable range of action during darkness.

Who Profits in Radio?

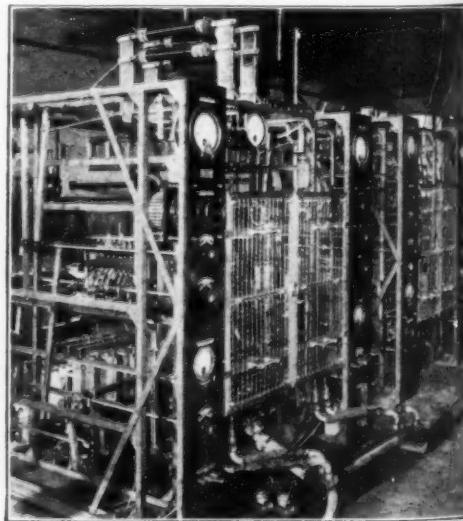
WHAT are the broadcasters getting out of broadcasting? One large operator in the field is reported to have lost 800,000 dollars in one year. There is a reason for radio manufacturers staying in the broadcasting business, because if broadcasting stopped, the sale of receivers would cease. No one would need their product. Some seem to think that "good will" and "indirect advertising" are the solution, but others are beginning to wonder if there are enough returns to warrant going on the air with "good will" broadcasts. "We must sell direct and know what results we are getting," they say. There seems to be a growing incentive to sell direct by radio. But what will the Federal Radio Commission say about it?

The Henry Field Seed Company, owners of station KFN, Shenandoah, Iowa, went on the air in 1925. That year the gross



Herbert

A general view of some of the radio transmitting equipment employed at the 20-kilowatt experimental station of the British Broadcasting Company. This station, 5SW, is at Chelmsford, England



Herbert

Two panels of the Marconi short wave equipment at 5SW show in the foreground. Copper screens shield all of the apparatus

April 1928

sales of seeds and nursery stock totaled 900,000 dollars. The gross sales in 1927 went up to more than two and a half millions, of which a million and a half were general merchandise. Last year they began to sell automobile tires and in less than eight months they had disposed of more than 340,000 dollars worth. Then the company tried to sell shoes and sold 50,000 dollars worth in six months. They dispose of hams and bacon at the rate of half a carload a week. That is what direct selling over the radio has done among the farmers of the midwest. The microphone is apparently a profitable and high-powered salesman. The question is, how would the air advertising in New York compare in results with that wafted across the corn belt?

New Cone Loudspeaker

IT has always been a matter of common knowledge that a cone loudspeaker, in which the vibrating surface is comparatively free from contact with stationary objects, will give the best reproduction. In an endeavor to attain as close to complete freedom as possible, the new type of cone loudspeaker illustrated in this column has been designed. The greatest novelty is that the apex has been completely cut



Courtesy Peter Poddell Company

This latest type of loudspeaker has no apex. A metal "spider" couples the cone to the reproducer

away and the surface of the cone has been attached to the driving mechanism by means of a four-legged spider of light sheet metal. By means of this construction, a comparatively small surface of the cone is clamped—only four small points near the center and four points on the outer edge have been fastened.

It is claimed that with this type of construction, the resulting reproducer more nearly attains that reproduction which is the product of the use of a cone and horn loudspeaker in the same circuit. It is said that the highest notes of the soprano and the lowest tones of the base viol are reproduced with as perfect fidelity as is possible, when radio transmission and reception limits are considered.

Static's Enemies

AT present, the best way to avoid static interference is to make the signal stronger than the static, according to L. W. Austin, of the Bureau of Standards. Dr.

Names—and what they mean



Paisley Shawls

The soul of a city was once woven into a shawl. The masterpiece was named after the city where the shawl was created—Paisley, Scotland. Famed for its magnificent abbey, its county and municipal buildings, the skill and thrift of its inhabitants, Paisley enjoys a world-wide reputation for the quality of the products from the looms of its many mills. Whatever is done in Paisley is well done. At one time the sale of Paisley shawls brought more than \$4,000,000 annually to the coffers of the city. The Paisley shawl, as every woman knows, is characterized by the elaboration of its design and the glowing harmony, brilliance, beauty, depth and enduring qualities of its colors. Other shawls there are, but none so well known and so eagerly sought for as the Paisley. It is worthy of note that some names begin by being merely tags to identify a product and are soon forgotten. Other names, like Paisley, acquire, through years of superlative merit in the product itself, a personality, a definite measure of value that is quickly recognized. Such a name, for instance, is

In the world of textiles and textile manufacture, there are almost numberless processes—some crude and others subtle—which are the means to the end that you may have what your heart desires in fabrics and for which your purse may pay in the clothes you wear. The woolens and cottons, the silks and satins and the many other fabrics that give protection to the body and satisfy the love of correct fashion, brilliant or subdued colorings, plain or intricate weaves are yours in greater variety now than ever in the history of the world, because of the part TYCOS Temperature Instruments play in the chemical processes that produce the dyes, in the sizing of the yarns and weaving of threads, in the drying and shrinking of fabrics where heat is a factor that must always be under control. The textile mills of the world find in TYCOS Temperature Instruments the agencies for indicating, recording and controlling temperatures to the end that your clothes may wear longer, possess greater beauty and cost less. What is true of TYCOS applications in the Textile Industry is true in all other industries.

Tycos Temperature Instruments

INDICATING - RECORDING - CONTROLLING

Office Thermometers
An aid in promoting human efficiency.

Bath Thermometers
To enable you to get the most good from your bath.

Home Sets
Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

Wall Thermometers
To help you maintain a temperature in your house conducive to good health.

FOR THE MEDICAL PROFESSION
Sphygmomanometers, Pocket, Office and Recording types. Urinalysis Glassware. Fever Thermometers.

Quality Compasses
To show you the right way in unfamiliar country.

Fever Thermometers
A necessity in every home.

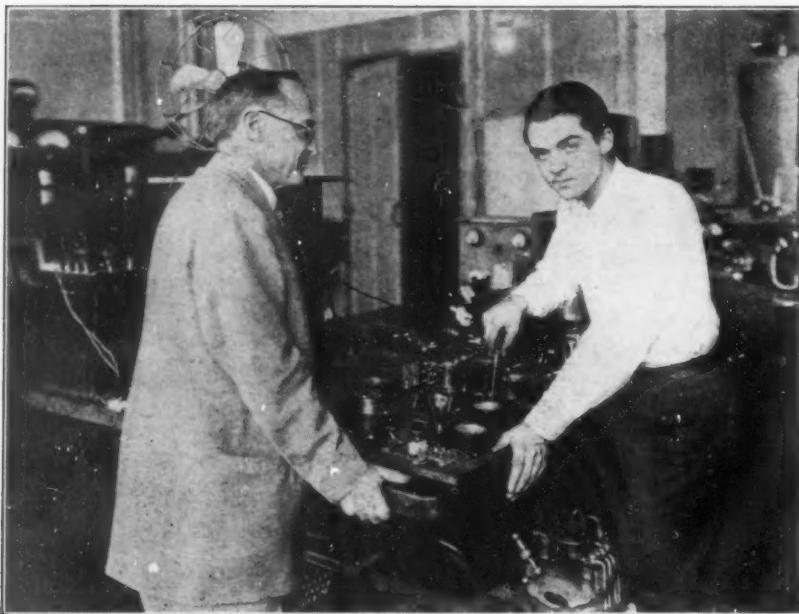
Stormoguides
Forecast the weather twenty-four hours ahead with dependable accuracy.

Hygrometers
To enable you to keep the humidity of the atmosphere in your home correct at all times.

Taylor Instrument Companies
ROCHESTER, N.Y., U.S.A.

CANADIAN PLANT
TYCOS BUILDING
TORONTO

MANUFACTURING DISTRIBUTORS
IN GREAT BRITAIN
SHORT & MASON, LTD., LONDON



Wide World

Christy Mathewson, Jr., son of the famous baseball player, was graduated from Bucknell University last June, and is now employed in the research laboratories of the General Electric Company, at Schenectady, New York

Austin explains that the conquering of static by high power at the sending station is evidently limited by economic considerations, for doubling the power of a sending station only increases the amplitude of its waves by about one and one-half times, since the amplitude increases as the square root of the power. Therefore, at a distance of several hundred miles, any probable increase in station power will not be able to drown out static when it is very severe.

It must be concluded, therefore, that static seems to have the best of us, except when we are close to the transmitting station, because with all the powers of nature behind it, it will continue to be able at times to drown out our human efforts.

It is pointed out that the chief reason why it is so difficult to eliminate static is that it comes from so many different sources of disturbance. It is as though nature were sending from thousands of stations of her own, radio waves tuned to all possible wavelengths, and frequently of great power. So the result is that, since static is coming in on all wavelengths, no matter where we tune our receiving apparatus, it is impossible to avoid it.

The only difference between the static waves and the waves from radio stations is that the static is highly damped, that is, very broadly tuned as compared with the usual ether waves. This enables sharply tuned receivers to discriminate to a certain extent in favor of the radio signals, since the sharper the receiver tuning, the narrower the band of static which is being received. But even at best this affords very little help.

Europe's Broadcasts

NOT only in quantity but in quality European broadcasting has points of superiority over that of America, according to Dr. J. H. Dellinger of the Bureau of Standards who recently returned from Europe.

programs to audience, and in general value of the broadcast material to the listeners, taking account of the absence of advertising, European radio is rather superior to ours.

"Because of the funds available from taxes on the listeners, European broadcasting stations are able to play an important role in the support and encouragement of musical art."

Comments on Television

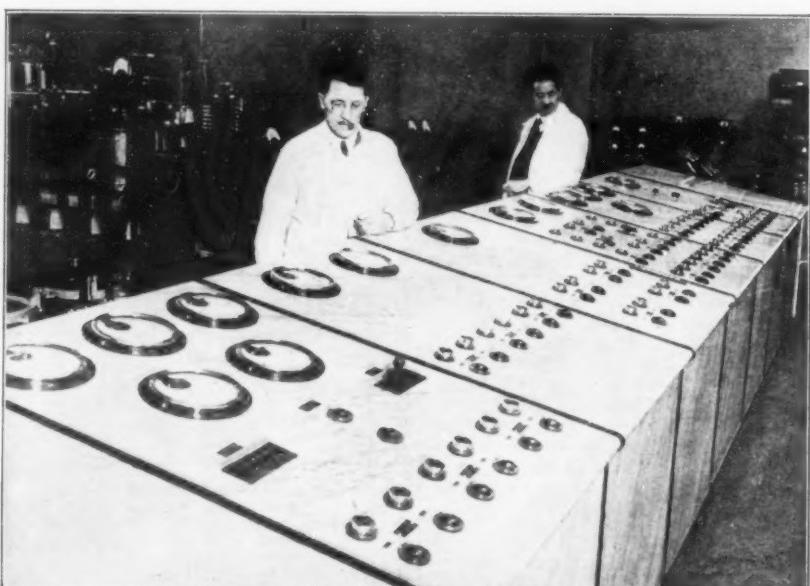
As a result of the recent demonstration of television given by the General Electric Company and described in the March, 1928, issue of this magazine, there have been many opinions expressed. Several of the most interesting ones follow:

"Television is still hanging on the apron strings of the laboratory," said Bond P. Geddes, vice president of the Radio Manufacturers Association. "When it begins to travel alone on a wide scale, as does broadcasting, it will be a novelty for some years to come, as was broadcasting. Today the aperture of the machine is too small, but there is no doubt that the screen will be enlarged."

A representative of the National Broadcasting Company said that there was nothing definite upon which to build for the future as far as planning television programs is concerned.

Samuel L. Rothafel, known to radio audiences as "Roxy," said: "We welcome the advent of television as an addition to progress. When the occasion arises we will harness it to our needs as we have radio. Speaking from the point of view of a motion picture producer, there is nothing to worry about. It will not reduce the size of motion picture audiences."

J. Andrew White, president of the Columbia Broadcasting System, said: "The first and most logical application of television apparatus, I think, would be for events such as championship boxing matches, or to carry the picture story of the arrival of a Lindbergh to an audience assembled in a large hall or theater. Eventually it will arrive in the home, but its most apparent



P and A
The most powerful wireless station in western Europe was recently opened at Zeesen, Germany. The station operates on a wavelength of 1250 meters and employs 120 kilowatts. Photograph shows the instrument control board

first application will be where audiences can hear and see such events as they take place. Television should in no way be competitive to the present system of entertainment, but greatly assist the business."

"I do not think that any marked advance has been made in the Alexanderson television apparatus," said Dr. Lee de Forest, inventor of the three-element vacuum tube, "except in the synchronization system. I think that television will never be practical in the home, due to the fact that the present methods require large rotating parts operated by a motor. The difficulty is that the operator at the receiving end must constantly regulate a little knob or dial, to prevent the picture from becoming distorted. Automatic synchronization, which would overcome this obstacle, is mighty expensive and I doubt that it will ever be used in the homes. We are still a million miles away from the application of television on a large theater screen, because 18 inches today constitutes approximately the largest television screen in use. A new system must be developed, based on another branch of physics, which will get away from heavy and rotating parts before seeing by radio can be made practical for private use."

Radio Units

FOR the constructor who likes to try out new circuits, the completely wired radio units such as the one illustrated in this column will be found of great value. These



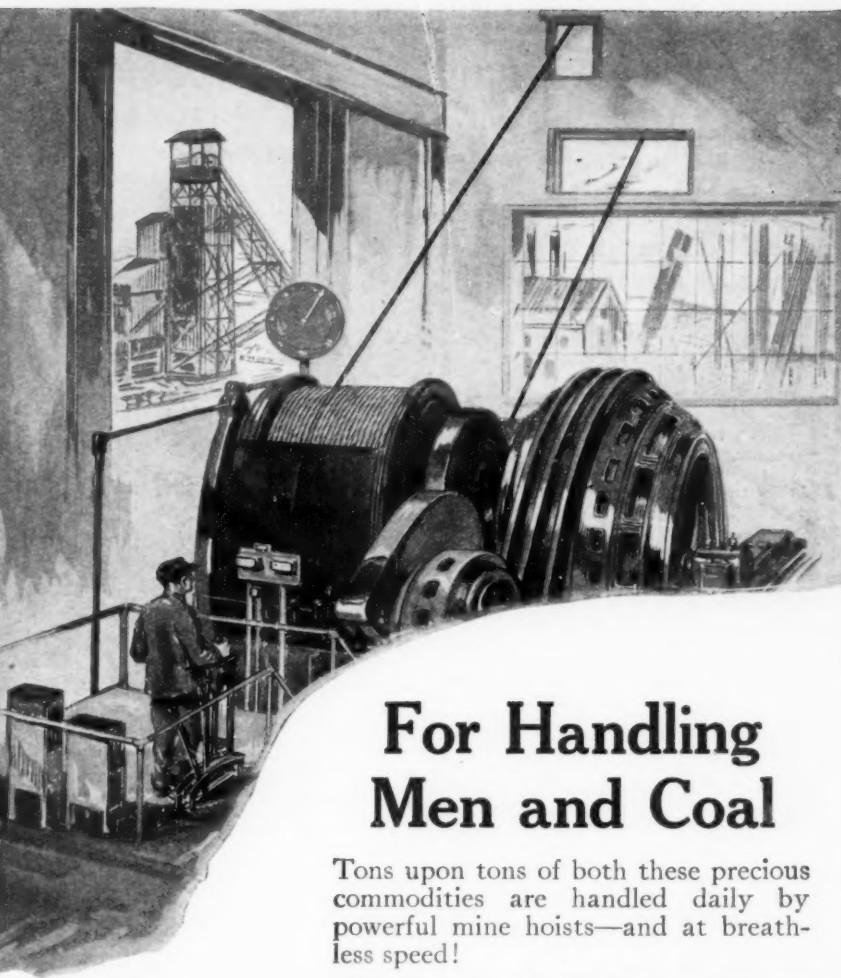
The latest in simplified radio equipment. Units are easily hooked up

units do away with all soldering and make hooking-up of even a multi-tube circuit very simple.

These radio units come in different types such as radio-frequency amplifiers, detectors, resistance coupled audio-frequency amplifiers and transformer coupled audio-frequency amplifiers. They are manufactured by the Pilot Electric Manufacturing Company, Inc., Brooklyn, New York.

18,000,000 Receivers

LAWRENCE D. BATSON, of the Department of Commerce, has completed a very thorough and interesting survey of radio on an international scale. Roughly he estimates that there are 18,000,000 receivers now in tune with the ethereal entertainment. With an average of five listeners per family for each set, the



For Handling Men and Coal

Tons upon tons of both these precious commodities are handled daily by powerful mine hoists—and at breathless speed!

Weight and speed combine to give the hoisting ropes a severe and strenuous life. Only the highest grade can hold out for long—a good reason why Yellow Strand is so widely used.

For heavy duty at your plant, Yellow Strand will give the same long, satisfactory service that the miner gets. The *strand of yellow* protects you.

This company of pioneer wire rope manufacturers also makes all standard grades for all purposes.

BRODERICK & BASCOM ROPE CO.

843 North First Street, St. Louis, Mo.
Eastern Office and Warehouse: 68 Washington St., New York City
Western Office: Seattle Factories: St. Louis and Seattle
Authorized Dealers in all Industrial Localities

Yellow Strand WIRE ROPE

LR453

When Do Improvements Improve?

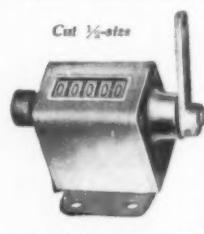
EVERY change in machine design or method of operating is for better or worse; no telling before the try-out. The sooner you know when you're bettering things, the surer you work out improvements. Without wasting time you'd like to know how each new development affects the output. Your machines will tell you immediately on

Veeder COUNTERS

Below is small Set-Back Ratchet Counter, which indicates one for each throw of the lever, moving through an angle of 45 degrees. Reset to zero from any figure by turning knob.

A very free and easy-moving counter, requiring little power to actuate it. Has stops to limit the throw of the lever, with return-action spring to bring lever to its initial position. Applicable to a wide range of light machinery. Price, \$6.00. Equipped with lock and key to prevent tampering with the record, \$2.00 extra. Also furnished in a Revolution Counter.

Cut 1/2-size



The large Re-Set Revolution Counter above records the output of the larger machines where the revolutions of a shaft record operations or output. Counts one for each revolution, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price, with four figures, as illustrated, \$10.00 (subject to discount). Similar model in a Rotary Ratchet Counter (with re-set), price \$11.50—list.

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The Veeder Mfg. Co., 18 Sargeant St.
Hartford, Conn.

total audience is placed at 90,000,000. Only a small portion of the globe is provided with dependable or consistent reception. If all the world had radio facilities at its finger tips as have New York listeners, it would be a great boon to the industry, and at least 200,000,000 more sets would probably be sold. The saturation point in radio is far, far, away!

Radio Trails Across the Sea

JOHN HAYS HAMMOND, Jr., defines "radio trails" as "lines more or less resembling standard telegraph lines, except



Metropolitan Photo Service

Experimental tests with the Cooley photo-ray system of radio photograph transmission were recently carried out successfully from radio station WOR. The photograph above shows the simple apparatus that Mr. Cooley employs for his work. A phonograph motor supplies the power for rotating the cylinder upon which the photograph to be transmitted is placed as shown

that they would not follow the curves of a railroad or a highway, but would be set up across country in a straight line between two terminal points of air travel. Each wire of this system would radiate, throughout its length, electro-magnetic waves, based on a method evolved for standard radio broadcasting.

"The airplane would be equipped with a directional receiving apparatus, which would be responsive to the wave sent forth by the trail wires. The pilot would receive the distinctive letter of the trail that he wished to follow, would orient himself to parallelism with it by his directional receiver, and would be able to maintain his position directly above the line and follow it into port."

Will Present-Day Sets Become Obsolete?

A PROBLEM which is of great importance not only to the radio public but the manufacturer as well is that which concerns the production of new yearly models in radio receivers. The average radio buyer wants to know whether or not his set will soon become obsolete because of newer and more improved sets being brought out. An opinion recently expressed by George Scoville, of the National Electrical Manufacturers Association, Radio Division,

Will Your Patent Pay?

"If I had read your book several years ago it would have saved me many thousands of dollars," writes an inventor who today is making more than \$100,000 a year.

INVENTIONS and PATENTS Their Development and Promotion

By MILTON WRIGHT

225 pages of sound, practical advice to inventors. Chapters include:

- The Field for Invention
- Why Get A Patent?
- Choosing a Patent Attorney
- Through the Patent Office
- When Inventions Conflict
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- Traps Set for Patentees
- What is the Patent Worth?
- Finding the Buyer
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- Royalties
- Selling the Patented Article
- Patenting Abroad
- Advertising and Publicity
- How to Raise Capital
- Trademarks and Patents
- Infringement
- Inventing as a Profession
- Twenty Don'ts for Inventors
- The Questions Inventors Ask

SCIENTIFIC AMERICAN

seems to indicate that with the present tendency there need be no fear of the higher class of sets becoming obsolete.

According to Mr. Scoville, the better manufacturers have designed their sets with provisions for keeping the audio-frequency part of the equipment as modern as the radio art itself. He points out the fact that the only features of the average sets which are likely to become obsolete are the appearance of the receiver and its controls. This, however, is something that can be readily remedied by exercising good engineering judgment and sound manufacturing experience.

The Photo-Electric Cell in Television

In all methods of communication by electricity it is necessary to convert the original message from sound or light to electrical impulses for transmission, and then back to sound or light at the receiving end. Thus the carbon grain transmitter is the essential converter of the voice for telephone and radio transmission. In like manner, television makes use of an instrument that will change the light waves from the subject to the electrical impulses which are broadcast by radio or sent by wire to the audience. This instrument is the photoelectric cell. (See page 246, March, 1928, issue.)

A thin coating of one of the alkali metals on the inside of a vacuum tube will give off electrons when light shines upon it. Very much like the human eye, this cell responds in proportion to the light intensity. Its action is practically instantaneous, so that it will give a faithful electrical replica of a



General Electric Company

Photo-electric cell of the type employed in the Alexanderson television transmitter. Note the size as compared with the standard tube socket in which it is placed

varying light source. All that is necessary in the tube is an anode or positive terminal to which the electrons may be drawn by a "B"-battery potential. By the use of a properly designed amplifying circuit the light variations may thus be transformed into a pulsating current of any desired strength which is used to modulate the

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sending wave of a radio transmitter exactly as do the voice currents from the broadcasting microphone.

Opportunity Knocking

WITH the courts supporting the tuned radio-frequency patents controlled by the Radio Corporation of America, research engineers are scratching their heads more than ever and are working overtime in an effort to discover a new type of circuit or principle that can be employed in receiving without violating

existing patents. Several prominent radio engineers are working on this problem and should they be successful the award will be more than glory!

Goldsmith is President of Radio Engineers

AT the general executive session of the Third Annual Convention of the Institute of Radio Engineers, Dr. Alfred N. Goldsmith, chief broadcast engineer of the Radio Corporation of America, was installed as president.

The Heavens in April

By PROF. HENRY NORRIS RUSSELL, Ph.D.



At 11 o'clock: Apr. 7.

At 10½ o'clock: Apr. 14.

At 10 o'clock: Apr. 22.

At 9 o'clock: May 7.

At 8½ o'clock: May 15.

At 8 o'clock: May 23.

The hours given are in Eastern Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on April 7, etc.

NIGHT SKY: APRIL AND MAY

The Heavens

ONLY Auriga, Gemini, and Canis Minor are left of the winter constellations and they are low in the west. Leo is high in the southwest and Virgo in the south, with Hydra below both. The Southern Cross can be seen low on the horizon from points in southern Florida and beyond. Bootes is high in the east; Ophiuchus below Scorpio rising in the southeast and Hercules well up in the northeast with Lyra below and Cygnus rising. Cassiopeia and Cepheus are low in the north, while Draco and Ursa Minor are higher, and Ursa Major very high.

The Planets

Mercury is still a morning star but is visible only in the early part of the month and then with difficulty, as he rises but 45 minutes before the Sun.

Venus is a morning star, too, but close to

Mercury and far more conspicuous. On the 8th, the planets are only one degree apart.

Mars is in Capricornus and rises about 3:30 A.M. in the middle of the month.

Jupiter is in conjunction with the Sun on the 6th and is invisible.

Saturn is past quadrature and comes to the meridian between 3 and 4 A.M.

Uranus is too near the Sun to be seen well, while Neptune is well visible (telescopically) in the evening sky.

The Moon is full at 11 P.M. on April 4th; in her last quarter at 3 A.M. on the 13th; new just after midnight on the 20th; and in her first quarter at 5 P.M. on the 26th. She is nearest the Earth on the 20th and farthest away on the 8th. During the month she passes near Neptune on the 1st, Saturn on the 10th, Mars on the 16th, Uranus, Venus, and Mercury on the 18th, Jupiter on the 19th and Neptune again on the 28th. None of these conjunctions are close.

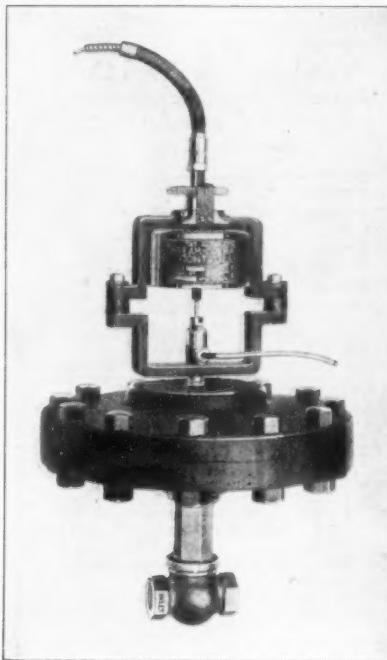
The Scientific American Digest
(Continued from page 352)

According to Mr. Found, the use of low voltage is made possible by a hot cathode within the tube, which provides sufficient electron emission to supply the current for the luminous discharge, and also results in increased length of life of the lamp. "We have found in tests," he said, "that there is less tendency for the neon gas to disappear and blacken the lamp when low voltages are used."

The beacon lamp consists of a small quartz tube wound in a close spiral one and one half inches in diameter. This is done for the purpose of obtaining as nearly as possible a concentrated spot of high brilliancy which can be placed at the focal point of the usual type of searchlight reflector. By this means a narrow concentrated beam of colored light can be made to reach much farther than the light from a larger tube.

Steam-Operated Steam Controller

A NEW type of steam operated controller which utilizes a portion of the steam in the pipe line which it controls to work the valves, the opening and closing of which govern the temperature of the apparatus to which the steam is ad-



Simplicity and ruggedness of the controller is readily apparent

mitted, is a recent development of the C. J. Tagliabue Manufacturing Company, Brooklyn, New York, as reported in a recent issue of *Power*.

The controller consists of three principal parts—the control valve *A* of the globe type, diaphragm *B* for operating the valve, and the pilot valve *C*.

Referring to the cross-sectional view, steam from the inlet side of the valve is admitted to the chamber *D* below the diaphragm through the opening *E*, and also to the chamber *F* above the diaphragm through the opening *C* shown dotted in the upper end of the valve spindle *H*. If the steam in the chamber *F* above the dia-

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1927 A PROSPEROUS YEAR

New insurance paid for in 1927	Over	\$927,000,000
Insurance owned by policy-holders on December 31	Over	\$6,285,000,000
Number of policies owned by them		2,381,186

1927 PAYMENTS to POLICY-HOLDERS and BENEFICIARIES

Paid to living policy-holders	Over	\$90,500,000
Paid to Beneficiaries in Death Claims	Over	\$48,500,000
Dividends (included above)	Over	\$53,000,000
Paid policy-holders and beneficiaries since organization	Over	\$2,640,000,000

CREDIT and DEBIT SUMMARY on DEC. 31, 1927

Amount of the Company's obligations (liabilities) and the funds held to meet them, showing a surplus or general contingency fund of \$115,227,812.30

ASSETS

Real Estate owned and First Mortgage Loans on Farms, Homes and Business Property	\$503,308,744.93
Bonds of the United States, Other Governments, States, Cities, Counties, Public Utilities, Railroads, etc.	628,437,285.07
Policy Loans, Cash and Other Assets	269,330,791.52
Total Funds for Policy-holders' Protection	\$1,401,076,821.52

LIABILITIES

Reserves—ample with future premiums & Interest to pay all insurance & annuity obligations as they become due	\$1,215,522,705.25
Dividends payable to policy-holders in 1928	59,886,112.00
All other Liabilities	10,440,191.97
Total Liabilities	\$1,285,849,009.22
General Contingency Fund	115,227,812.30
Total	\$1,401,076,821.52

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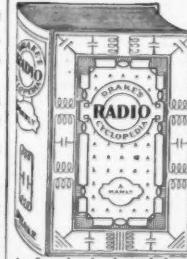
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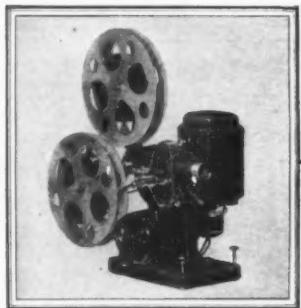
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phragm is not allowed to escape, the pressure on each side of the diaphragm will be equalized and the valve will be held to its seat by the spring J. But when the steam above the diaphragm is released at a faster rate than it is admitted through the opening G, the differential of pressure exerts an upward force on the diaphragm and the valve is opened against the pressure of the spring J. The amount of opening through

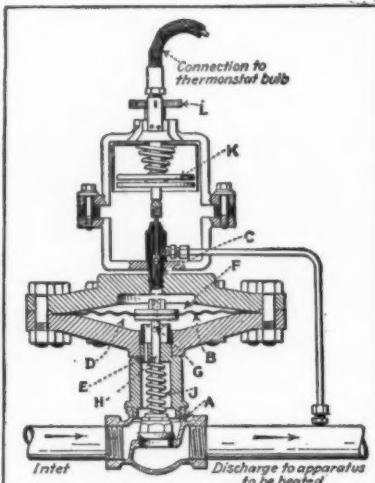


Diagram to show working parts of the controller, inlet and outlet for steam, and diaphragm

the pilot valve C governs at all times the opening through the main valve A from "cracked" to full opening.

The pilot valve C is operated by a metallic bellows K, the movement of which is in turn controlled by a thermostat bulb inserted in the tank or other vessel in which the liquid is being heated and to which steam is being admitted.

Adjustment of the setting point within the range of the controller is made by means of the knurled dial at the top of the controller head.

The controller is adaptable to a large number of services and is made in the direct-connected type, and the wall type in which the controller head is mounted on the wall at some convenient point remote from the valve that it controls.

The controller is designed to operate on pressures between five and 100 pounds, and for use as temperature controller is furnished with a 40-degree range anywhere between the limits of 95 and 290 degrees Fahrenheit. The size of the steam valve ranges in standard pipe sizes all the way from one half of an inch to four inches.

Semi-Automatic Shoulder Rifles Wanted by War Department

THE War Department is interested in securing a satisfactory, developed semi-automatic shoulder rifle. The general requirements of such an arm are as follows:

The rifle must be of a self-loading type, adapted to function with cartridges of caliber .276 to be furnished by the Ordnance Department. The cartridge will be approximately the following characteristics: bullet, flat base, gilding metal jacket, weight 140 grains; cartridge case, double taper, semi-rim type; powder charge sufficient to impart a muzzle velocity of 2600 feet per second to the bullet heretofore

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described; for working powder pressures, the limit will be approximately 45,000 pounds per square inch. The rifle must be simple and rugged in construction and easy of manufacture. It should require but little more attention than the regular service rifle when placed in the hands of the average soldier.

It is planned that competitive tests of arms of this character will be held about January 1, 1929. The War Department may receive and subject to preliminary examination and test such rifles as inventors may care to submit prior to competitive trials.

Persons having semi-automatic rifles which they desire to submit for competitive test should address the application for such tests to the Chief of Ordnance, United States Army, Washington, D. C.

For the guidance of inventors in perfecting a design of this type, and for full details of the tests, queries should be addressed to the officer above mentioned.

"Micro-Movies" Aid Study of Bacteria

THE private lives of bacteria at war and at work can now be filmed. Dr. S. Bayne-Jones of the University of Rochester Medical School has taken motion pictures of thousands of generations of bacteria that enable a spectator to follow them through many days of growth and activity in a few minutes.

"Micro-movies" will aid biologists in working out obscure growth processes of many rudimentary forms of life, it is said, and in addition, classroom reels may be made for the instruction of students of medicine and industrial bacteriology.—*Science Service*.

New Fragrant Fertilizers

FARMERS and gardeners, whose nostrils are sensitive but who judge the value of commercial fertilizer by the robustness of its reek, will welcome the news that recent United States Bureau of Soils tests have found in certain common commercial by-products, excellent fertilizers of unoffending odor.

The farmer of the future who uses cocoa meal as a fertilizer may well start his daily plowing with a song, for from his fields the winds will waft a pleasing fragrance like a freshly opened can of breakfast cocoa.

At present this by-product of cocoa and chocolate manufacture is little used as a fertilizer, but it may be produced cheaply in great quantities and soon may be extremely useful.

Some 20,000 tons of by-product cocoa cake, from which the meal is ground, are made annually in the United States. It resembles breakfast cocoa but is of lower grade, with less fat content, and is made by the pressing of roasted and shelled cocoa beans.

Other by-products of the cocoa industry that show fertilizer possibilities are cocoa meal shell and presscake, or defatted cocoa. Cocoa cake contains 4 percent nitrogen, shells about 3 percent, and presscake, 4 percent.

Other new fertilizers, dried crab waste, shrimp waste and shrimp bran, have a distinct fishy smell, somewhat like that of the common commercial varieties. After drying they are richer in plant food elements than cocoa by-products.—*Science Service*.

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Industries From Atoms

(Continued from page 359)

Aldehydes and ketones are present in the unpurified products, but these will probably be removed in preparing the finished lacquer solvents. The aldehydes and ketones in turn can be converted into derivatives of value in the rubber and other industries.

Compressed Gas as Motor Fuel

In a communication to the World Motor Transport Congress, recently held in London, M. L. Bacqueyrisse, director general of the Paris Motor Bus Company, gave some interesting details of experiments in the use of coal gas as a substitute for gasoline, which are being conducted by his company. For the purpose of the experiments, a motor truck has been equipped with a set of six steel cylinders containing gas supplied by the Paris Gas Company and compressed to 150 kilos per square centimeter. The Paris Bus Company has designed and perfected a special form of carburetor, or gas-air mixer.

The results of the tests are said to have been entirely satisfactory as regards the working of the apparatus, the motor and the power developed. The observed consumption, after the motor had been tuned up, and for the normal operation of the truck, was 0.632 cubic meters of gas, having a calorific value of 4500 calories per cubic meter against 0.4 liter of liquid fuel rated at 8240 calories per liter. The respective consumptions in calories therefore are 2850 for coal gas against 3290 for gasoline, the economy in favor of gas being 10 percent. In M. Bacqueyrisse's opinion, this saving can be attributed to the fact that the gas-air mixture is more homogeneous than that resulting from the vaporization of liquid fuels.

Experiments in connection with the compression of the gas carried out by the Paris Gas Company have shown that it is advisable to use a gas containing not more than 2 percent by volume of oxygen, in order to eliminate the risk of explosion.

Celluloid-Rubber Nuptials

MANY a chemist, giving free rein to fancy, has toyed with the idea of "crossing" two dissimilar substances to produce an offspring combining the desirable properties of each, as Burbank did successfully in his garden. Unfortunately, the progeny of such unions in the field of chemistry are too often "black sheep." A recent development in this direction, however, is the marriage of celluloid with rubber, the admirable but widely different qualities of which are well known.

This union is now accomplished on an experimental scale through the medium of a solvent known as cyclohexanol, or hexalin. Hexalin or its conversion products are capable of dissolving both crude and vulcanized rubber. The solvent action is exercised both quickly and perfectly and at lower temperatures than is the case with most other solvents. It has been found that celluloid and rubber can each be dissolved in hexalin and the two solutions afterwards combined. If this mixture is then applied to a glass plate and the solvent allowed to evaporate, a fine celluloid-rubber film is obtained.

Hexalin is a neutral water-white liquid and, like all higher alcohols, does not dis-



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solve readily in water. Its specific gravity is 0.975, equivalent to 7.9 pounds per gallon. It boils at 155-160 degrees Centigrade, and flashes at about 168 degrees Centigrade. No discoloration takes place on standing and it is very stable even at the boiling point and evaporates without residue. Like amyl alcohol, hexalin has a high dissolving capacity for solid and liquid hydro-carbons, fats, oils, resins, waxes, et cetera.

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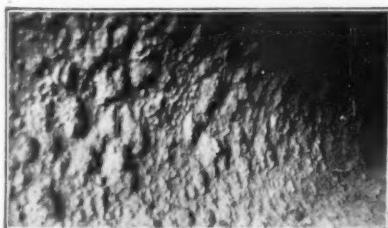
Measuring Anti-knock Values

THE tendency of a fuel to cause knocks in an internal combustion engine may be intimately related to the temperature at which it takes fire spontaneously, according to H. J. Masson and William F. Hamilton of New York University, who have recently investigated the subject. They have found that those fuels which take fire at low temperatures tend to cause knocks more easily than those requiring higher temperatures to ignite them.

Preventing Corrosion of Water Mains

CORROSION of iron pipes used to carry water is a serious problem and methods of preventing it have been given much study. The proposal of a treatment of the water itself to reduce its tendency to corrode iron was made at a recent meeting of the American Chemical Society by John R. Baylis, who said:

"Corrosion of iron is costing a sum far greater than is generally believed. Taking all factors into consideration, such as pipe repairs, loss of water through leaks, damage to property, the necessity for larger pipes when it is known that the carrying capacity will be greatly reduced by the formation of iron rust, fire losses due to inadequate water pressure caused from a partial



Tubercles on the inner surface of a 40-inch cast-iron water pipe that has been in service for about 30 years. Some of the tubercles project as much as two inches. They restrict the flow of water

stoppage of the mains, staining of bathroom fixtures and clothes being laundered, and other losses, the total economic loss due to corrosion is quite large.

"For corrosive water such as is found in a number of cities, it is believed that a fair estimate of the loss is at least \$1.50 per capita annually. This figure is merely a guess, but those who have had to pay a plumber for repairing leaks or removing corroded pipes will realize that it takes only a few leaks in a lifetime to make the repair cost as much as this figure. At Baltimore the cost of lime to make the



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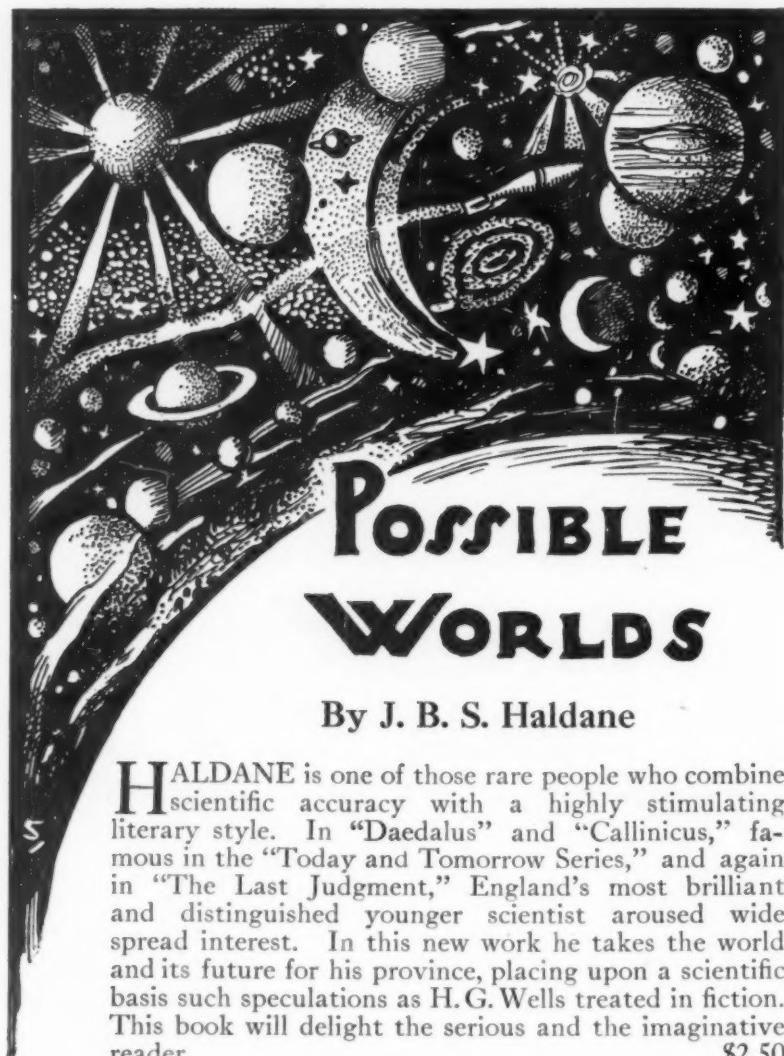
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water fairly non-corrosive has averaged about two cents per capita annually for the past three years. To this should be added a cost estimated to be less than ten cents per capita for the increased hardness. If a non-corrosive water will reduce the total losses due to corrosion one half, which the speaker feels confident it will where the water is originally very corrosive, the saving will be from 50 to 75 cents per capita annually. Corrosive water is not satisfactory to the users, and while it is difficult to estimate the value of satisfaction, it may be a sum even more than the total losses due to corrosion.

"Iron will probably continue to be the most extensively used material for water pipes. Whether it is galvanized, painted with coal-tar pitch, or cement-lined, evidence indicates that it is durable only when the water is saturated with calcium carbonate, or more alkaline. Then it seems that the economical limit of treatment should be somewhere near the saturation point of this compound, or perhaps just slightly more alkaline. Regardless of the source of supply, it is believed that water which is corrosive to calcium carbonate should be treated, unless it is a small supply where the cost of treatment would be excessive.

"Waterworks officials are beginning to recognize the value of chemical control for the prevention of corrosion and tuberculation of water mains. In the few cities where it has been tried, the treatment suggested in this paper has been found of decided economic value. Not only this, but the water is more satisfactory to the users than it was before starting the treatment. Some of our most palatable spring waters are at approximately the saturation equilibrium of calcium carbonate, and no one should hesitate to add lime or soda to drinking water. Even if the use of cement-lined pipe proves to be the solution of the corrosion problem, there are many million dollars worth of iron pipe not lined with cement now in service and in need of protection against corrosion."

Measurement of Rubber Strength

SO intimately is the strength of a mixture such as rubber related to the surface of the particles of solid matter distributed through it, that the mere measurement of the size of minute particles of carbon or other pigment gives an accurate index of the strength of the rubber compound.

Automobile tires, made by vulcanizing a mixture of carbon-black with rubber, owe their strength and wear-resistance to the extensive surface of the pigment and rubber in contact with each other. By measuring the size of the particles of solid material in the rubber dough, it is possible to determine the amount of surface which exists in the tire, and thus its finished strength. A simple examination of a rubber compound beneath a high-power microscope thus yields invaluable information about its properties.

Airplanes Fight Weevils

SUCCESSFUL utilization of the airplane for the spraying of alfalfa fields suffering from the alfalfa weevil is reported to the War Department from Utah, where an army plane was recently used to spray poison on three test fields.



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(Continued from page 356)

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Imperial Airways

THE Directors' Report of the British Imperial Airways attracted universal attention in Europe, and almost as much interest in aviation circles in the United States.

The report covered the year ending March 31, 1927. Since January 1, 1925, Imperial Airways have carried 52,000 passengers and flown two and one half million miles, without a single accident causing injury to passengers.

Our own air transport operators will probably be gratified to learn that the British company also flew 60,000 miles on special charters for business houses, newspapers and others requiring quick travel at short notice. Work of this character should ultimately be a source of real revenue.

The year yielded a trading profit of 150,000 dollars, as compared with a loss of nearly 100,000 dollars for the preceding year. It should be noted that British subsidies are comparatively moderate and that French companies with heavier subsidies are sometimes able to lower rates to an economically unreasonable level.

Imperial Airways have now been operating long enough for their practice in depreciation to be a useful guide. They wrote off, for their aircraft and engines units, something less than 10 percent of the total value of such materials. Such a percentage is decidedly encouraging, even though a larger reserve was made for obsolescence of equipment.

The directors rightly emphasize the value of standardizing equipment. Their fleet now comprises aircraft equipped with 18,102 horsepower in 18 planes, yet the planes used in regular transport operation comprise really only two types.

Weather still remains a preponderating factor in regularity of operation, in spite of all aids to navigation such as beacons and wireless. For the European operations—London to Paris mainly—the regularity or percentage of flights completed as per schedule was 92 percent. In the splendid climate of the middle East—Cairo to Basra—in spite of flight over desert territory, the regularity was 100 percent—a record worthy of note.

Only political complications have prevented the completion of the plans which will carry the service from Cairo, Egypt, to India.

Apparently the British company is really overcoming all difficulties and getting its services on a strictly commercial basis, in the third or fourth year of operation. Our own operators should therefore face with patience the difficulties they are experiencing in the second year of their services. They still have much to learn about successful commercial aviation.

Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

The Turnover in Toast

THE Westinghouse Electric and Manufacturing Company has gone into court with its electric toaster. This is the toaster in which the toast does a somersault when you pull down the frame. The suit for infringement of the patent (obtained by Wiltsie) was brought against the Rock Island Manufacturing Company, the Circuit Court of Appeals for the Seventh Circuit hearing the appeal.

"Wiltsie's conception, as he described and preempted it in these claims," Judge Alscluler finds, "was to have his carrier so constructed that its integral element supporting the slice would be removed from under it by the act of dropping the carrier, whereupon the toast would drop downward and slide forward."

"The alleged infringing device shows a radically different method for bringing about the dropping and sliding forward of the slice. It has the frame, heating element, grids, and carriers hinged at bottom of frame; all of which are old. But the support for the toast is not in the carrier at all, but on the bottom of the frame, and but for some actuating mechanism might remain in the frame until Doomsday after the carrier was dropped."

"Wiltsie's operation is through gravity alone, by suddenly withdrawing the toast support, which is part of the carrier. In appellee's device there is interposed a separate mechanism which drives the toast away from its support. Both methods may reverse the slice, and both may produce good toast; and while the result in each may be the same, the means for accomplishing it are quite different."

"While it may be that Wiltsie is entitled to a fair range of equivalents, we do not think one of them is a device wherein the means which support the toast are not a part of the carrier itself. We are satisfied that the claims in issue do not read upon appellee's device, and that appellee does not infringe the Wiltsie patent."

Where Registration Is Obligatory

NEW YORK STATE has adopted a unique law providing for the proper marking of articles made of platinum or similar precious metals and defining the marks to be used. A striking paragraph reads as follows:

"If there is any quality mark printed, stamped or branded on the article itself, there must also be printed, stamped or branded on the said article itself the following mark, to wit: a trademark, duly applied for or registered under the laws of the United States, of the manufacturer."

If you are a manufacturing jeweler in New York, you cannot mark an article "platinum" unless it is of the required degree of purity. And if you do mark it "platinum," you must also place on the article your trademark duly registered (or applied for) in the United States Patent Office. If your trademark is not registered

in the Patent Office, you must register it there before you can mark your article "platinum."

Making or selling platinum articles to which is applied the quality mark without adding the trademark constitutes a misdemeanor and is punishable by a fine of not more than one thousand dollars, imprisonment for six months or both.

Peanut Trademarks

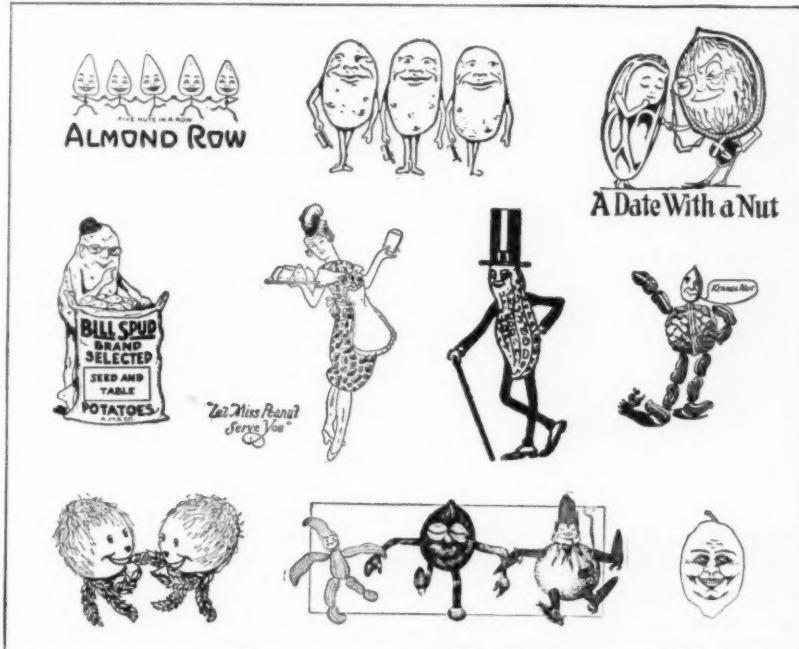
THERE is no monopoly in the use of a picture of a peanut as part of a trademark, the Patent Office holds. So many people have used it that when a new applicant comes along, the only question the Patent Office has to decide is whether it so nearly resembles one of the others as to cause confusion.

Recently C. K. Jelks and Son, manufacturers of peanut products, applied for

cant's mark and those of the opposer, and in view of the prior registrations showing that the feature common to the applicant's and opposer's marks had previously been adopted by others for goods of the same descriptive properties, it is believed that no confusion would arise in the mind of the public as to the origin or ownership of the goods of the parties by the concurrent use of their respective trademarks, and that the opposer's trademark rights do not merit such a broad construction as to exclude the applicant's trademark from registration."

Interchangeable Auto Wheels

SO accustomed has the public become to the fact that the front and rear wheels of an automobile are interchangeable that the decision of the Circuit Court of Appeals for the Seventh Circuit holding valid the patent for this feature comes as something



Does Miss Peanut too closely resemble Mr. Peanut? On the evidence of these other trademarks the Patent Office says she does not

registration of picture of a female figure in the costume of a waitress, the dress simulating the form of a peanut shell. The words "Let Miss Peanut Serve You" were used.

The Planters Nut and Chocolate Company opposed the registration, contending the public would confuse Miss Peanut with their famous "Mr. Peanut" registered as a trademark both by words and by pictures.

The Jelks company produced a large number of marks tending to show that there is nothing original in picturing peanuts. After studying them Assistant Commissioner Moore finds:

"In view of the dissimilarity of the appli-

cation's mark and those of the opposer, and in view of the prior registrations showing that the feature common to the applicant's and opposer's marks had previously been adopted by others for goods of the same descriptive properties, it is believed that no confusion would arise in the mind of the public as to the origin or ownership of the goods of the parties by the concurrent use of their respective trademarks, and that the opposer's trademark rights do not merit such a broad construction as to exclude the applicant's trademark from registration."

The interchangeable wheel patent was issued to Edward P. Cowles, of Sparta, Michigan, on July 14, 1914, and assigned to the Packard Motor Company. In upholding the patent, Judge Evans finds:

"Cowles' invention dates back to 1899. The art prior to the advent of the automobile was represented by wheels on

wagons, buggies, and other vehicles. Their purposes and uses were quite different from those on the automobile, and naturally the hub and wheel structures were different. The automobile necessitated a set of driving wheels and a set of steering wheels both equipped with pneumatic tires. The hub structure of the driving wheels differed from the hub structure of the steering wheels. To solve the problem of the blows and wheel breakage, Cowles offered his conception of an interchangeable wheel with its unique hub receiving mechanism. It is, therefore, apparent that he approached a somewhat different problem than that which confronted the wagon maker.

"There was nothing in the prior art that suggested his wheel or hub structure. It was conceded novel. Likewise, useful. The extent of its use is involved in some doubt and dispute but it can at least be described as extensive. Its commercial value was clearly established. Likewise, there was acquiescence in, and a recognition of, the validity of his patent by manufacturers and dealers."

Referring to an English invention made about the same time, he says:

"The advent of the automobile brought many problems for the mechanic, the manufacturer, and the inventor. The rewards obtainable for improvement or advance in the industry were large and attractive. A consuming interest in the industry and in each and every advance therein was manifested by the people of the United States and England. It is not surprising that out of all those engaged in solving tire troubles, two—one in the United States and one in England—should have approached the problem in the same way and offered a similar solution.

"The fact that a mechanic other than the patentee offered a somewhat similar solution does not then conclusively negative invention. Grant that in the instant suit (and each case must stand on its own facts so far as invention is concerned) a border line case is before us. The determinative factors in such a situation are all on the side of the patent. Utility—large use—recognition by manufacturers—presumptions by reason of the patent office grant in the United States and in England—the conclusion of the District Judge—all unite to sustain the patent."

What Is a Patent Attorney?

TESTIMONY has been taken by the Committee on Patents of the House of Representatives on a bill introduced by Representative Cramton of Michigan, to classify persons representing inventors in the Patent Office. The measure is designed to prevent practice by unauthorized persons and to protect inventors from becoming the victims of unscrupulous practices.

At present "patent attorney" is a term used to designate anyone who makes a profession of obtaining patents for inventors. A patent attorney need not be a lawyer.

Under the terms of the bill the following kinds of persons would be clearly distinguished:

Patent Attorneys—members of the bar who are registered to practice before the Patent Office.

Patent Agents—persons not members of the bar who are registered to practice before the Patent Office.

Attorneys in fact—persons who are practicing in the patent business, but who are

not registered to practice before the Patent Office. The Patent Office will not recognize the status of such persons.

Under the existing law, Patent Commissioner Robertson explains, the Patent Office is helpless to prevent a person disbarred from practice, or not registered, from getting patent business and carrying it on with the Patent Office in the name of his client. The proposed legislation provides penalties for fraud and questionable practice and permits United States Attorneys to institute prosecutions.

Employer and Employee

INVENTIONS made by an employee are a frequent source of dispute, especially where the patent is obtained after the inventor goes to another employer. A case in point was provided by the action brought by the Elzwilaw Company against the Knoxville Glove Company. The court decreed that the former employer, the Knoxville Company, possessed a shop right to manufacture under the patent.

Messrs. Elsey, Zwick, and Lawson, comprising the Elzwilaw Company, applied for a patent on a leather reinforcement for a cloth working glove, on the palm and fingers, leaving the cloth over the backs of the finger joints exposed, to facilitate flexibility of the glove at the joints. While the application was pending, the Knoxville Company employed Lawson to take charge of the manufacture of gloves at their recently acquired factory at Knoxville. He became a stockholder and officer, and for more than two years superintended the manufacturing operations.

Lawson mentioned to his employers the pending patent application and recom-

mended their making gloves in accordance with it. With his employer's consent and at their expense he had patterns and dies made and manufactured a few dozen pairs of gloves. They did not seem to be just right and the experiments were continued. Lawson left the company and sold out his interests. The experiments were still carried on by the company and finally a glove was produced which met with some success in the trade. Later, in 1920, a patent was issued to Lawson, Elsey, and Zwick. In 1921, Kyle, president of the Knoxville Company, filed an application for a patent, claiming he was the first inventor of the finger back reinforcement. This patent issued the following year.

"If it be assumed that appellee's alleged infringing glove," Judge Alscherer of the Circuit Court of Appeals for the Seventh Circuit finds, "falls within the Lawson, *et al.*, patent, we are satisfied the evidence warrants the conclusion of a shop right in appellee. While it is true that the invention was made before Lawson, one of the inventors, became connected with appellee, yet it was Lawson, as one of appellee's stockholders and officers, and as a superintendent of manufacture, who expended much of appellee's time and considerable of its money in adapting the invention to practical use in appellee's business.

"The experimentation and expense proceeded during the two years of his association with appellee. If at that time his efforts had been attended with success, and a considerable trade established in gloves made under that patent, it would scarcely be questioned that a shop right accrued to appellee.

"If the final step which led to a successful application of the patent to appellee's business was not taken until after Lawson's

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Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

MUFFLER FOR AIRPLANE MOTORS—Comprising a pipe for receiving exhaust gas, and a rotor for drawing a current of air to abstract the exhaust gas from the pipe. Patent 1656576. M. S. Sullivan, 248 Congress St., Charleston, S. C.

AMPHIBIAN BALLOON—Capable of navigating in the air or upon the surface of the water, novel gas chambers being constructed to avoid quick changes of temperature. Patent 1656780. F. G. Diago, Aptdo 1972, Habana, Cuba.

AIRSHIP—Of the buoyant type, having long cylinders of light weight construction, made in upper and lower halves, with a flexible longitudinal diaphragm, for receiving gas or air. Patent 1656137. A. Bradford, 5642 42nd Ave., S. E. Portland, Ore.

ATTACHMENT FOR KITES AND THE LIKE—By which heavier than air articles can be lifted and automatically released at any predetermined height and allowed to precipitate to the earth. Patent 1655794. C. E. Moore, 1268 W. 83 St., Los Angeles, Calif.

Pertaining to Apparel

VEST—Which will conform to the body at all times and will yield in response to muscular

movements without discomfort to the wearer. Patent 1656145. R. E. Davis, c/o W. B. Davis & Sons, Fort Payne, Ala.

GLOVE—Of the slip-on type, wherein a clamping action is provided which absolutely secures the glove in place and which gives a pleasing appearance. Patent 1655295. I. Steinberger, c/o Steinberger Bros. Glove Corp., 230 5th Ave., New York, N. Y.

CAP SHAPE RETAINER—Comprising a frame of light resilient wire adapted to be placed in the crown of a cap to maintain the same in proper distended form. Patent 1656073. R. P. Nixon, Main St., Forest Grove, Ore.

Chemical Processes

SALT GRAINER—Constructed with a specially formed hood or cover for the purpose of increasing the production of salt by utilizing heat now generally wasted. Patent 1656827. R. G. Peters, c/o J. R. Peters, Manistee, Mich.

Designs

DESIGN FOR A TEXTILE FABRIC—The inventor has been granted two ornamental designs for textile fabrics. Patents 74098 and 74099. C. A. Cottaz, c/o Sherman & Lebaour Co., 183 Madison Ave., New York, N. Y.

relations with appellee had ceased, should appellee be held thereby to have lost the benefit of its previous expenditures and efforts to that end under the patentee's direction?

"We think not; but rather that, in fairness, they were authorized to continue to make available to them the investment and experimentation theretofore made with Lawson's direction and co-operation in the undertaking to employ his invention in the joint enterprise of himself and the others interested in appellee corporation."

Divorcing a Trademark From a Product

THAT the purpose of a trademark is to identify the origin of goods is an axiom of trademark law. Circumstances may arise, however, which leave one man owning the trademark and another the original goods, with each hampering the sales of the other. Such a curious set of facts has been brought to light by the refusal of Judge Mack in the Federal Court for the Southern District of New York to grant to Muelhens and Kropff, Incorporated, an injunction restraining Ferdinand Muelhens, Incorporated, from using the famous trademark, "4711," for eau de cologne.

Since 1792, the Muelhens family has been making eau de cologne at 4711 Glockengasse, Cologne, Germany, according to a secret recipe transmitted from father to son. Under the trademark, "4711," the business became world-wide. Kropff came to the United States in 1878 as the Muelhens agent. In 1889 Ferdinand Muelhens and Kropff became partners, but the secret formula remained with Muelhens. The trademark was registered.

During the World War the Alien Property Custodian seized the business of the partnership and sold the legal right to the trademark and the good will of the business to the plaintiff. The secret recipe was not known in this country and was no part of the good will. There was, of course, no jurisdiction over Muelhens, but only over his property in this country. The American firm sought an injunction against the German firm.

"It seems to me apparent from the affidavits of the experts," Judge Mack holds, "that there is no real identity of the two products. Plaintiff's product may or may not be as good as the original '4711'; it is not, however, the original. Plaintiff is attempting to palm off a substitute article under what I must at present deem the false claim that it knows and has the original recipe.

"If plaintiff has acquired the trademark in connection with the business, it nevertheless cannot properly use it so as to lead the public to believe that the product sold by it is identical with the product for which the mark originally stood."

Filaments for Electric Lights

THE General Electric Company's patents (one by Fagan and one by Frech and Fagan), under which tungsten light filaments are placed in incandescent lamps, have been held valid by the New Jersey Federal District Court. The patents were the subject of an infringement suit brought against Charles Eisler and the Eisler Engineering Company, both of whom have been engaged in the manufacture and sale of machinery for lamp and radio building. In his opinion finding the defendants were in-

SCIENTIFIC AMERICAN

DESIGN FOR A DRESS—Patent 74094. Katherine E. Burns, c/o Franklin Simon Co., 38th St. and 5th Ave., New York, N. Y.

DESIGN FOR A DRESS—Patent 74155. Mildred C. Schmolze, c/o Franklin Simon Co., 38th St. and 5th Ave., New York, N. Y.

DESIGN FOR A CHILD'S COSTUMER—Patent 74158. Margaret A. York, 15 W. 12th St., New York, N. Y.

DESIGN FOR A LOUD SPEAKER—Patent 74164. M. Morris, 1445 Madison Ave., New York, N. Y.

DESIGN FOR A LAMP SHADE—Patent 73976. A. J. Hammond, Ben Lomond, Calif.

DESIGN FOR AN END CAP FOR EAVES TROUGHS—Patent 74234. C. A. Meunier, c/o Cam Mfg. Co., Great Neck, L. I., N. Y.

DESIGN FOR A DRESS—The inventor has been granted two patents 74212 and 74253. Katherine E. Burns, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A DRESS—The inventor has been granted two patents 74275 and 74276. Mildred C. Schmolze, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A SMOKING PIPE—Patent 74334. A. J. Sorbello, 365 Washington St., New York, N. Y.

Electrical Devices

EXPLOSIVE BLOW-OUT SWITCH—Which is instantly disconnected when more than a predetermined amount of current passes therethrough, the separation causing no possible short circuit. Patent 1654467. J. P. Medlin, P. O. Box 1739, Great Falls, Mont.

ELECTRICAL MEASURING INSTRUMENT—For quickly determining the ohmic resistance of any given conducting element without requiring any setting of rheostats by hand, or any of the usual performances. Patent 1656116. W. E. Hull, R. F. D. No. 54, Sharpsville, Pa.

_SOUND ELIMINATOR FOR RADIO TUBES—Wherein a rubber ring is clamped to the large part of the radio tube to dampen or completely eliminate sound produced by friction. Patent 1657390. A. Kalikman, c/o King Tire Co., 125 W. 67th St., New York, N. Y.

VARIABLE CONDENSER—For receiving and transmitting in radio, telephone and telegraph apparatus, which by the use of tubular stator and movable elements completely eliminates the use of plates. Patent 1655784. J. A. Garcia, 1831 Sawtelle Blvd., Sawtelle, Calif.

ELECTRICAL CONNECTOR—By which a pair of conductors may be twisted together in such manner as to form a perfect contact, protected, concealed, and without danger of fouling. Patent 1657933. W. E. Linsley, 433 Berry St., Brooklyn, N. Y.

SHIP TELEGRAPH—Which consists of a relay so associated with each order signal that only the intended signals will become operative upon the transmission of an order. Patent 1657928. W. R. Hornberger, 2534 So. Shields St., Philadelphia, Pa.

Of Interest to Farmers

PLOW—For use on tractors, so constructed that as many as three disc plows may be mounted on a single push bar without interfering with the control. Patent 1656354. L. C. Hester, Box 255, Jacksonville, Fla.

WEEDER ATTACHMENT FOR HARROWS—In the form of a scraper blade at the rear of the harrow which will bodily remove the weeds and break up and level the earth. Patent 1656788. W. C. Hanna, and A. Huff, c/o Johnson Bros., Dufur, Oregon.

FERTILIZER DISTRIBUTOR—Of strong and durable construction and effective to properly

fringing, Judge Bodine gives an interesting summary of the development of electric lamp making.

"The early incandescent lamps made by Edison contained a carbon filament," he says. "This filament was of such high resistance that a short length was sufficient. The material itself was strong and fairly stiff so that it was not necessary to use anchor wires to give it support. It was enough to loop the filament from one lead-in wire to another. Tantalum filaments, which later came into use, had a much lower resistance so that greater length of wire was required. A new problem arose in finding a method of supporting the filament, not only because it was longer than the old carbon filament, but because of its relative weakness and small diameter. The customary way of supporting the filament was to wind it over hooks supported from a central glass stem. The hooks were inserted into buttons so that they radiated like spokes in a wheel. These hooks were made of fine wire and the number depended upon the size of the bulk and the resistance of the filament used.

"The tungsten filament now in common use permits of a reduction in the number of supports. The insertion of the hooks in a button in a spider or spoke-like arrangement was done at first by hand. The operator picked up one of the minute hooks and placed it on the button, which was softened by a flame, with the right side up. These hooks had to be spaced circumferentially. They also had to be properly spaced radially; that is, they must not extend in too far, otherwise they were short circuited. The operator placing these hooks around the button was likely to burn one off while putting another on, or if this did not occur it was apt to oxidize so that the hook sagged and lost shape.

"In the Bergmann patent number 198-249, of September, 1907, the hooks were inserted in a mold circumferentially, the ends projecting into the mold. Then the end of the rod was heated and thrust down into the mold so that the glass was molded around them.

"No other satisfactory method was produced until Fagan secured patent Number 1128120, which shows a machine for putting the several hooks forming the spider around the cane simultaneously, the button upon which the hooks are placed having been previously formed in the same machine."

Inventions By Government Employees

THE army and navy want legislation which will encourage officers and enlisted men to develop inventions which will be of use to the government. So declared Colonel J. I. McMullin, of the Judge Advocate General's Office, when he appeared before the House of Representatives Committee on Patents recently, in behalf of two bills (H.R. 6103 and H.R. 6105) introduced by Representative Vestal, of Indiana.

The first measure would permit a government employee to obtain a patent without paying a fee, provided that he state that the invention might be used by the government for governmental purposes without payment of a royalty. The second measure authorizes the government to license patents which it owns to individuals, firms, and corporations, under regulations promulgated by a commission comprising the Secretaries of War, Commerce, and Navy.

distribute the desired quantity of fertilizer over the ground and cover the fertilizer with soil. Patent 1657197. A. J. Chesson, Kinston, N. C.

Of General Interest

COMBINED SEAT AND DESK—Which may be turned as a unit about a vertical axis, and readily secured in any one of a plurality of positions. Patent 1654455. S. W. Conwell, General Delivery, Wallace, Idaho.

SUPPORTING FIXTURE—Which may be rigidly held in place without the aid of screws, nails, or other fastening means, for supporting shades, drapes, or the like. Patent 1653742. A. E. Sparrow, 6146 Langley Ave., Chicago, Ill.

SMOKING PIPE—In which the vaporous nicotine and other highly volatile oils distilled from the burning tobacco will be trapped and condensed before reaching the mouth. Patent 1654384. M. Pirec, c/o Ludwig Krause, Little Falls, N. J.

DISPLAYING AND DISPENSING APPARATUS FOR BEVERAGES—Which displays a continuous stream or fountain of the beverage while affording means for dispensing the same from a cooled container. Patent 1654379. W. Matzka, 11 E. 45th St., New York, N. Y.

SIGN—Having photoluminescent indicia defined thereon, and intermittently subjected to a source of light which is stored up and subsequently given off when the light is removed. Patent 1654370. D. M. Goettachius, c/o Radium Dial Co., 3532 Forbes St., Pittsburgh, Pa.

STAPLE—A strip embodying a multiplicity of preformed staples, and integral alternately disposed offset portions for connecting the staples together. Patent 1654371. C. B. Goodstein, c/o E. G. Oppenheim, 514 W. 57th St., New York, N. Y.

BOOKRACK—For adjustably supporting a book or magazine in position for reading, the device is adapted to be secured to a bed post, or such support. Patent 1654027. J. G. Westerfors, 429 East 67th St., Los Angeles, Calif.

LABEL HOLDER—Which may be quickly secured to the back of a loose leaf-post binder, for holding labels by which the records therein can be identified. Patent 1653346. F. H. Crump, 225 East 4th St., Los Angeles, Calif.

STORM-SEWER INLET—In which the grating is so curved that it creates a greater clearance into the sewer, without creating a sudden drop from the road surface. Patent 1654886. W. E. Keeble and A. Gunselmann, c/o W. E. Keeble, City Hall, Temple, Texas.

PICTURE FRAME FOR FOUNTAIN PENS—Which combines a frame and fountain pen cap, with the parts so arranged that the picture is protected yet constantly exposed to view. Patent 1655365. M. Cortov, 1418 5th Ave., New York, N. Y.

MEMENTO NOVELTY SOUVENIR—Which is especially attractive as an ornament and as a means for preserving photographic records of vacations, and to commemorate other special events. Patent 1655341. J. A. Snellgrove, Hotel McAlpin, 34th St. & Broadway, New York, N. Y.

PROCESS OF MAKING POWDERED OR GRANULAR JELLIFYING COMPOUND—Which comprises dissolving pectin in water with fruit acid, then adding sucrose, and immediately drying the solution. Compound can be stored and will not coagulate. Patent 1655398. H. T. Leo, c/o H. J. Leo Pectin Sales Co., 903 North Main St., Los Angeles, Calif.

TOBACCO PIPE—In which the smoke is purified during its passage to the mouth-piece, and the nicotine reservoir cleaned by the removal of the mouth-piece. Patent 1656112. G. Grenier, c/o C. Chassevent, 11 Boulevard de Nagenta, Paris, France.

METAL DRAIN FOR ROADWAYS—Designed especially for use through the ridge of roadway embankment to prevent excessive erosions which commonly cause washouts, the device may be easily laid. Patent 1655321. G. K. Mack and

W. J. Berryman, 309 Citizens Bank Bldg., Edenton, N. C.

HAIR-WAVING PAD—Which differs from those in general use by reason of its not containing any hair softening substances, such substances being applied direct to the hair. Patent 1656136. W. J. Boecklen, 39 W. 46th St., New York, N. Y.

COMBINATION MATCH CASE AND IGNITER—Can be easily operated to light a match, project the same after ignition, and hold it during the lighting of a cigar or the like. Patent 1656060. P. Glavey, Jr., 265 Mott Ave., Long Island City, N. Y.

DISPLAY CARD—Formed from a single blank of cardboard or similar material and having means for supporting a bottle or similar container and advertising matter. Patent 1657381. F. E. Everson, 15 Barry Place, Scarsdale, N. Y.

COMBINED TOE PAD, CALLUS RELIEVER, AND BUNION SHIELD—A compressible resilient pad for the relief and correction of deformities, capable of ready reversibility for use on right or left foot. Patent 1656135. J. J. Blanchfield, c/o James J. Tighe, 574 3rd Ave., New York, N. Y.

FLOAT FOR USE IN BATHING—A float upon which the bather may prostrate himself face down, and cause movement to himself and the device through the water. Patent 1656840. E. S. Stanton, 52 Franklin St., Brooklyn, N. Y.

COMBINATION IRONING BOARD AND STAND—Which will fold flat against a standard sized household board, with no parts projecting beyond the ends, will occupy little space when stored. Patent 1656789. W. E. Haskin, c/o Pressed & Welded Steel Products Co., Long Island City, N. Y.

TOBACCO PIPE—In which the tube terminates in a head forming a rose, providing a perfect draft, and a flange isolates the tobacco, and prevents the passage of nicotine. Patent 1656787. G. Grenier, c/o C. Chassevent, 11 Boulevard de Magenta, Paris, France.

CONNECTOR—Capable of many uses, such as building toys, ornamental iron work, and in any capacity where it is desired to detachably connect one element to another. Patent 1655662. T. Repay, c/o Fernando Spangenberg, Route 1, Box 161, Lathrop, Calif.

NIPPLE FOR NURSING BOTTLES—So constructed that only a portion of the nipple can be taken into the mouth, preventing distortion and allowing the admission of air with the nourishment. Patent 1656157. J. L. Correnti, 1423 Wybro Way, City Terrace, Los Angeles, Cal.

WRITING AND DRAWING PENCIL—With changeable leads projected forward to the pencil point from a magazine by means of an actuating member of simple construction. Patent 1657408. J. E. Platon, c/o Stockholm Patentbyra, 7 Vasagatan, Stockholm, Sweden.

DISPLAY DEVICE—Particularly suited for display in beauty shops and other establishments where the hair is treated or preparations for the hair are sold. Patent 1657413. L. Schumer, 548 Amboy St., Brooklyn, N. Y.

BUILDING CONSTRUCTION AND BLOCK—The concrete blocks being so formed that they are anchored to the footings, and the roof anchored to the walls, to withstand heavy wind storms. Patent 1657441. G. Huovinen, 233 E. Homestead Ave., Palisades Park, N. J.

WHEEL—With a rim stamped from a single piece of sheet metal, capable of easy assemblage for a clothesline pulley wheel, or other purposes. Patent 1657374. W. Dietzel, Merrick, L. I., N. Y.

DISPENSING PACKAGE—Particularly adapted for delicatessen stores and like places where waxed paper sheets are used, permitting the ready removal of the sheets, one at a time. Patent 1657942. L. C. Spaldo, Bush Terminal, Brooklyn, N. Y.

WATER AND GREASE PROOF CONTAINER—In which liquids or solids of a greasy nature can be held for an indefinite period without any deterioration in the quality of the contents. Patent 1656095. H. L. Carpenter, c/o Car-

penter Container Corp., 137 41st St., Brooklyn, N. Y.

CURTAIN STRETCHER—For gripping the curtain firmly along its edges and stretching it evenly, without the use of pins, so that it may be quickly removed. Patent 1657999. M. Kott, 1264 Sheridan Ave., Bronx, N. Y.

ANTIRODENT PREPARATION—Whereby the destruction of filled bags may be prevented, by treating the material from which the bags are made with an extract of coffee grounds. Patent 1653710. J. C. Kitchin, Box 515, Gridley, Calif.

FILM CLIP—To keep ends of roll film separated in developing tanks. It is stamped from a single piece of metal. Patent 1657678. P. J. Kirwan, Glenwood Springs, Colorado.

CARRYING CASE—Affording a convenient arrangement by which book matches are readily accessible in combination with a cigarette case, when a cigarette is removed for smoking. Patent 1657938. W. T. Roberts and G. A. Pike, 78 East St., North Attleboro, Mass.

Hardware and Tools

KEYLESS LOCK—Designed as a lock for trunks, including a bolt-releasing mechanism subject to practically unlimited variations, thereby insuring the user against duplication of the combination. Patent 1654440. A. T. Warren.

DOOR LATCH—Which may be conveniently secured to the outer face of a closure frame, such as a screen door or similar light closure, without boring. Patent 1657423. W. W. Van Duzer, 66 Main St., Warwick, N. J.

COMBINED DRILLING TOOL AND PUMP—For cutting into and breaking up material at the bottom of a well bore and confining the material so that it can be withdrawn. Patent 1656798. E. S. Sloan, Shippensburg, Pa.

WINDOW FASTENER—For automatically securing a sash in predetermined position, at the same time preventing unauthorized persons from the outside opening the window sufficiently to enter. Patent 1656818. J. W. Dillon, Box 302, Atlanta, Ga.

Heating and Lighting

RETORT FOR THE DISTILLATION OF OIL SHALES—Or similar substances, may be revolved and uniformly heated, will operate under a low pressure of vacuum and at a low temperature, thus saving time. Patent 1656107. L. T. Fairhall, 82 Ellery St., Cambridge, Mass.

Machines and Mechanical Devices

APPARATUS FOR TREATING BEANS AND OTHER PULSE FOODS—Which will readily remove the hulls from beans, after the beans have been steeped in water, without crushing or destroying the beans. Patent 1653506. H. P. Okie, 1225 Conn. Ave., N. W., Washington, D. C.

CORE FOR MOLDS FOR CASTING CURVED STEREOPLATES—Constructed to provide a more uniform temperature of the mold by means of a water jacket inside the core and specially formed ribs projecting therein. Patent 1655349. C. Winkler, c/o Winkler, Fallert & Co., Bern, Switzerland.

BEARER—For printing presses, having means for so securing the bearer to the press bed that the surface over which the cylinder travels will be uniform. Patent 1653912. C. B. Johnson, 148 Jefferson Ave., Hasbrouck Heights, N. J.

PACKING FOR AIR-PUMPS—Which may be lowered into a well for completely sealing off the space between the suction member of the foot piece and the well casing. Patent 1654395. G. M. Williamson, c/o Cook & Cook, Attns., Shreveport, La.

VOTING MACHINE—In which the operating functions are performed mechanically by balls dropped at various places designated with the candidates to be voted for. Patent 1654457. F. G. Diago, Aptd 1972, Habana, Cuba.

EDGER—A machine for edging lumber, for trimming either one or both bark edges of a board as it comes from the saw mill. Patent 1654435. G. S. Sergeant, c/o Sergeant Mfg. Co., Greensboro, N. C.

TOOL-SHARPENING MACHINE—Which will clamp a whetstone and give it a reciprocatory motion while the tool is held stationary and pressed upon the stone. Patent 1652469. W. K. Dodge, Box 665, Fort Bragg, Calif.

FRUIT PRESS—Wherein there is a division member at the bottom for dividing the pressed pulp so that it may be removed in sections. Patent 1655289. V. S. Perazio, 458 10th Ave., New York, N. Y.

TENSION FLYER FOR SPINNING MACHINES—Constructed to permit of its application in either direction for operation on either right or left twist machines, thereby rendering the same self-threading. Patent 1655352. E. Babcock and W. P. Watson, Phillipsburg, N. J.

FRUIT CRUSHER AND SQUEEZER—Which may be operated by power or hand, and is arranged for receiving the fruit at one point, discharging the juice and pulp at other points. Patent 1655333. V. S. Perazio, 458 10th Ave., New York, N. Y.

SEMI-AUTOMATIC TRIP FOR POWER SHOVELS—The operator actuating the shovel may also trip the same at any time during the movement of the lever or when the lever is stationary. Patent 1655623. G. G. Morin, 40 Florence Ave., Holyoke, Mass.

DISHWASHING MACHINE—Characterized by a rotatable dish holding basket, the rotation of the basket being successively produced by water jets acting upon the dishes. Patent 1656139. J. L. Breton, c/o C. Belettry, 2 Boulevard de Strasburg, Paris, France.

CUTTER BAR FOR MOWING MACHINES—Wherein the cutter bar is positionable to cut vegetation either horizontally or in an upward or downwardly inclined position, and the pitman eliminated. Patent 1656090. J. H. Webb, Pinedale, 265 E. 2nd St., Mesa, Arizona.

APRON FOR ORE ELEVATOR FEEDERS—Which will function to prevent loose material dropping from the buckets, but will yield in response to a relatively great stress, thus preventing injury. Patent 1656602. E. J. Ouellette, 406 East 4th St., Anaconda, Mont.

AUTOMATIC BOBBIN-CHANGING DEVICE FOR LOOMS—Characterized by a novel device for feeding in the bobbins, and securely holding a bobbin until the picker is again in position of rest. Patent 1656801. C. Valentin, c/o A. Elliot, 246 Fredericke Strasse, Berlin S. W. 48, Germany.

CLEANING DEVICE—Adapted to clean fabrics such as window shades, draperies, rugs, and carpets, has novel means for automatically releasing the fabric as rotation is stopped. Patent 1656479. O. Geisler, 6947 S. Peoria St., Chicago, Ill.

ROTARY CORE-DRILL ATTACHMENT—By which a sample core is formed and extracted to determine the character of the earth formation encountered when prospecting for oil. Patent 1656809. A. L. Armentrout and E. B. Hall, 1151 Temple St., Los Angeles, Calif.

CLEANER FOR STEAM BOILERS—Whereby the mud or other deposit on the boiler bottom, and also the tubes, may be removed daily without interruption of the production of steam. Patent 1656796. A. Richardson, 49 Meyers St., Nelsonville, Ohio.

BARREL-LABELING MACHINE—Which feeds one barrel or cylindrical object at a time, and positions the same for the printing of a circular series of labels. Patent 1657382. A. V. A. Felten, 20 Taconic St., Pittsfield, Mass.

VARIABLE LINE SPACER—A simple attachment which can be operated by one hand to transfer a rotary, to a longitudinal motion, causing variable line spacing in a typewriter. Patent 1657392. E. T. Harney, Garwood, N. J.

LIQUID METER—Comprising two vessels which are alternately filled and emptied, and in which the streaming in and out of the liquid is regulated by valves. Patent 1657383. J. H. F. Fitger, c/o Stockholm Patentbyra, 7 Vasagatan, Stockholm, Sweden.

WRIST PIN FOR MOWING MACHINES—Or other machinery, whereby the wrist pin may be securely fastened to the crank disk to prevent the pin from turning relative to the disk. Patent 1657419. O. D. Teel, Echo, Oregon.

PULVERIZING APPARATUS FOR SOLID FUELS—In which one member alone operates simultaneously the air delivery and the delivery of pulverized coal, to render a perfect combustion, without personal intervention. Patent 1656862. G. S. Loy, c/o Office Picard, 97 Rue St. Lazare, Paris, France.

CORE BARREL—Whereby a substantially solid uncontaminated core may be obtained from any formation, rock, shale or sand, and easily withdrawn for examination without injury. Patent 1657368. O. M. Carter, 206 Scanlan Bldg., Houston, Tex.

Medical and Surgical Devices

DENTAL CASTING MACHINE—So constructed as to permit the application of the proper degree of heat to the various portions of the mold for diversified operations. Patent 1653911. S. L. Jefferies, Box 305, Gaffney, S. C.

LINGUAL BAR—Having a flexible joint intermediate its ends so that the saddles of the plates may fit snugly and move in the mouth without injury. Patent 1654469. E. H. Peeil. McKinley Block, Anchorage, Alaska.

MEANS FOR PREDETERMINING DENTAL REPLACEMENT—Whereby the dentist may correctly display to the patient facsimiles or duplicates of the artificial teeth with which the patient is to be provided. Patent 1654387. B. F. Stenz, c/o Simplex Sampling Association, 211 11th Ave., New York, N. Y.

FOUNTAIN SYRINGE—Which is readily applicable to faucets, for utilizing and regulating the water pressure in intermixing medicaments before they are discharged interiorly of the body. Patent 1655664. J. Russell, P.O. Box 284, Riverside, Calif.

Prime Movers and Their Accessories

ENGINE BALANCE—A simple and reliable device which affords facilities for counteracting or neutralizing the forces which tend to cause vibration in a four-cylinder engine. Patent 1654515. W. R. Tompkins, Box 304, Rankin, Ill.

MOTOR—Having a connection between the crank shafts and each piston which will compensate for relative fore-and-aft rocking and lateral motion of the piston rods. Patent 1655338. W. J. Roe, 256 Liberty St., New York, N. Y.

ENGINE—Provided with a flywheel containing a countershaft directly geared to the crank shaft of the engine, so that vibration is minimized. Patent 1654792. A. Corona, 586 Rogers Ave., Brooklyn, N. Y.

CARBURETOR—A charge forming device for applying an internal combustion engine with an intimate mixture of air, vaporized fuel and water, and automatically controlling the flow. Patent 1657376. F. S. Dixon, Oneida, Fla.

Railways and their Accessories

SIGNAL DEVICE—An automatic device for railroad crossings, so constructed that the oncoming train will itself signal to motorists and pedestrians, its approach. Patent 1656822. B. Hybarger, Tangier, Ind.

Pertaining to Recreation

GEOGRAPHICAL EDUCATIONAL GAME APPARATUS—A form of spinning device which is

instructive in geography, incidentally gives some of the pleasurable benefits derived from traveling from place to place. Patent 1653464. J. T. Lomas, 507 West St., New York, N. Y.

SOUNDING TOY—A toy resembling a piece of artillery, wherein a decided musical sound is produced as the toy is moved over a surface. Patent 1654398. W. Bartholomae, c/o Bar Musical Novelty Co., 30 Great Jones St., New York, N. Y.

VEHICLE TOY—Comprising a plurality of elements capable of being readily disassembled and reassembled in various combinations to form toys simulating vehicles. Patent 1653291. W. I. Katow, 421 S. Harvard Blvd., Los Angeles, Calif.

TENNIS GAME BOARD—Which simulates a tennis court, or flat surface, over which game pieces, such as a disk, are projected by manipulations of the fingers. Patent 1654018. W. J. Schlosser, 225 East Craig Place, San Antonio, Texas.

PUZZLE—Including four isosceles triangles, three scalene triangles and two trapezoids, which when placed together will form a plurality of figures, including a rectangle and an arrow head. Patent 1656117. J. S. Joseph, cor. Walthall & Gibbs Sts., Greenwood, Miss.

GAME APPARATUS—Including a figure simulating a golf player "addressing" a ball, and means whereby the club head will contact with the ball to project the same. Patent 1657388. E. P. Gorman, 86 Grandview Ave., Rye, N. Y.

Pertaining to Vehicles

THEFT-PREVENTING DEVICE—A locking mechanism adapted to be adjustably supported upon a bicycle frame, and projected through the wheel to assume a locking position. Patent 1654017. J. Schlener, 3817 Louisiana Ave., Los Angeles, Calif.

MILEAGE METER—A rheostat which can be operated with the fuel supply system for indicating the rate of fuel consumption with respect to the rate of travel. Patent 1654421. H. J. Knerr, France Field, Canal Zone, Panama.

VEHICLE WHEEL—Having an inner inflated tire disposed between inner and outer jellies, and novel means for connecting the inner and outer jellies. Patent 1654367. A. Freund, P.O. Box 733, Central Station, St. Louis, Mo.

LICENSE NUMBER PLATE—Having bendable sealing members adapted to be bent to position to house the fastening nuts, whereby accidental loosening and loss are prevented. Patent 1655363. W. H. Fluker, c/o Eastern Mines Corp., Thomson, Georgia.

SHOCK ABSORBER—Operable automatically to permit unrestricted flexing of the springs, but to retard the reflexing to allow gradual return of the vehicle body to normal elevation. Patent 1654763. H. Tauscher, Cartago, Calif.

DRAWBAR ATTACHMENT FOR TRACTORS—Which will tend to prevent the rising of the front end of the tractor when a relatively heavy load is ascending a steep grade. Patent 1655376. G. E. Lee, Lynchburg, Va.

AUTOMOBILE SOAP SHOWER AND RINSING BRUSH—Whereby soap suds and water may be forced out through the bristles of the brush independently or in conjunction with a stream of clear water. Patent 1655375. W. Kundel, Box 226, Hoboken, N. J.

LOCK FOR PREVENTING THEFT OF AUTOMOBILES—Whereby the steering apparatus will be locked against movement, and a signal sounded if the lock is operated in an incorrect manner. Patent 1655350. R. Alfisi, 2243 83rd St., Brooklyn, N. Y.

VEHICLE WHEEL—Employing a solid cushion tread and a pneumatic hub structure, which will properly function on the application of relatively low air pressure, giving maximum buoyancy. Patent 1653348. G. E. Dudley, 1266 103rd Ave., Oakland, Calif.

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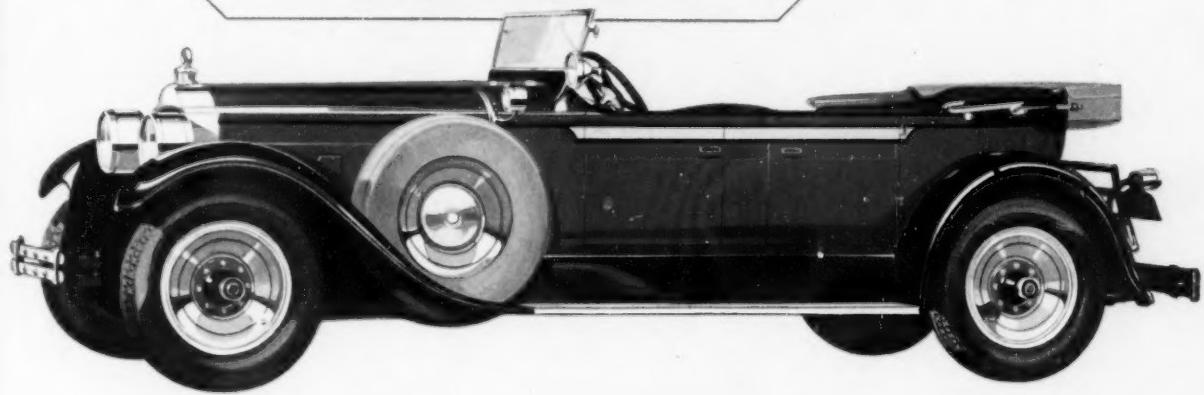
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